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THESIS

EVALUATING FORECASTING METHODS FOR CASH MANAGEMENT IN THE NAVY WORKING CAPITAL FUND

by

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December 1998

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13. ABSTRACT (maximum 200 words) This thesis researches business forecasting models and methodologies for application in the management of cash in the Navy Working Capital Fund (NWCF). The recent dissolution of the Defense Business Operations Fund (DBOF) and establishment of the service Working Capital Funds has resulted in an increased emphasis on effective cash management practices at the service level. Unpredicted outlays in an era of severely declining budgets have caused further scrutiny of cash management practices in the NWCF, which generates nearly \$20 billion annually in revenues and expenditures. Forecasting models within the NWCF and outside the Department of Defense were evaluated for potential application at the Assistant Secretary of the Navy (Financial Management & Comptroller) (ASN (FM&C) and Supply Management Activity Group (NWCF-SM) level of the NWCF. Specifically, the NWCF-SM expenditures forecasting model was analyzed and evaluated for possible implementation across all NWCF business activities. Additionally, a developmental cash management system was analyzed and recommendations were made for improvement. Finally, several forecasting methodologies and private sector forecasting benchmarks were discussed to illustrate techniques that may be applicable in NWCF cash management. Cash collection and disbursement data were collected at ASN (FM&C) and NWCF-SM and evaluated for forecasting possibilities in the aforementioned models and methodologies. A simple probabilistic model was presented for application in NWCF cash management.

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**EVALUATING FORECASTING METHODS FOR CASH
MANAGEMENT IN THE NAVY WORKING CAPITAL FUND**

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Submitted in partial fulfillment of the
Requirements for the degree of

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ABSTRACT

The recent dissolution of the Defense Business Operations Fund (DBOF) and establishment of the service Working Capital Funds has resulted in an increased emphasis on effective cash management practices at the service level. Unpredicted outlays in an era of severely declining budgets have caused further scrutiny of cash management practices in the NWCF, which generates nearly \$20 billion annually in revenues and expenditures. Forecasting models within the NWCF and outside the Department of Defense were evaluated for potential application at the Assistant Secretary of the Navy (Financial Management & Comptroller) (ASN (FM&C) and Supply Management Activity Group (NWCF-SM) levels of the NWCF. Specifically, the NWCF-SM expenditures forecasting model was analyzed and evaluated for possible implementation across all NWCF business activities. Additionally, a developmental cash management system was analyzed and recommendations were made for improvement. Finally, several forecasting methodologies and private sector forecasting benchmarks were discussed to illustrate techniques that may be applicable in NWCF cash management. Cash collection and disbursement data were collected at ASN (FM&C) and NWCF-SM and evaluated for forecasting possibilities in the aforementioned models and methodologies. A simple probabilistic model was presented for application in NWCF cash management.

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I. INTRODUCTION

A. BACKGROUND

The Navy Working Capital Fund (NWCF), a revolving fund, was established in December 1996 when the Under Secretary of Defense (Comptroller) separated the Defense Business Operations Fund (DBOF) into four working capital funds - Navy, Army, Air Force and Defense [Office of the Inspector General, Department of Defense (1997)]. The term “revolving fund” describes the mechanism used to finance the Navy’s business-like activities. Unlike an *appropriated* fund activity, which is financed through an annual appropriation of funds from congress, a revolving fund activity receives an *earned authority* for the amount of every customer order accepted. As work is accomplished, the revolving fund activity uses Working Capital Fund (WCF) cash to pay for the costs of performing work or providing material. Customers are then billed based on stabilized rates and prices, and the customers reimburse the WCF, replacing the cash. The fund “revolves” with an annual goal of a net operating result of zero – all costs covered and no profit retained [Department of Defense Publication (1996)].

The DBOF had been established in 1991 by consolidating nine existing industrial and stock funds, in an attempt to foster a more business-like approach to Defense depot maintenance, transportation, supply management, and accounting operations. Regardless of nomenclature, the intent of the revolving funds has been to focus management

attention on the total costs of essential Department of Defense business operations and to provide quality goods and services at the lowest cost [General Accounting Office (1997)].

The working capital funds are designed to operate on a break-even basis over time, with service and material rates based on predicted costs and business levels. Administration of a working capital fund carries Antideficiency Act responsibility [31 U.S.C. Section 1517]. The Under Secretary of Defense (Comptroller) also requires that the services maintain a 7-10 day balance of cash, plus investment cash. The Assistant Secretary of the Navy (Financial Management & Comptroller) (ASN (FM&C)) currently maintains a balance between \$400 and 700 million [10 U.S.C. Section 2208]. If NWCF activities fail to break even, due to higher than anticipated expenses or slower development of revenue, subsequent year rates must be raised to cover losses and maintain an adequate cash balance for bill payments and capital investments. Effective management of cash at all levels provides for stable rates and prevents over obligation of funds, or a failure to fully obligate funds authorized.

Historically, cash management resided with the major claimant responsible for a revolving fund. A major claimant is a bureau, office or headquarters, which is designated as an administering office under the Operations and Maintenance appropriation [Navy Comptroller Manual, Vol 2, Ch. 2]. Prior to the establishment of the DBOF, the two claimants involved in cash management were the Navy Supply Systems Command (NAVSUP), which managed the Navy Stock Fund, and Naval Sea Systems Command (NAVSEA), which managed the Navy Industrial Fund. Through the creation of the

DBOF, these responsibilities were transferred to the Office of the Secretary of Defense (OSD). Defense Management Review Decision (DMRD) 910 simultaneously consolidated accounting and finance functions and personnel into the Defense Finance and Accounting Service (DFAS). However, in 1995, OSD transferred cash management back to the services. The net result of these events was an eroded capability for the services to manage cash - to research and resolve accounting problems at all levels in the WCFs. Since the transfer of cash management and the creation of the WCFs, cash management has come under increasing congressional scrutiny and several General Accounting Office (GAO) and Department of Defense Inspector General (DODIG) reports have made specific recommendations for improving cash management within the WCFs [General Accounting Office (1997)].

Most recently, the Defense Working Capital Fund Congressional Study recommended that each service component develop a cash management model and develop standards to enable model employment in all Activity Groups, despite differences in business operations. The goal of this thesis is to assess existing models and business practices to determine if Activity Groups (AG's) in the NWCF can utilize an effective common model, or if models can be developed to improve and facilitate the budget development process.

B. OBJECTIVE

The research involved investigating improved cash management capabilities and forecasting techniques in the Navy Working Capital Fund. Specifically, forecasting models were researched and assessed, and existing models were evaluated for possible application in the NWCF budgeting process. The thesis research included (1) identification of forecasting methods and models currently being used for cash forecasting within the NWCF, and research of private-sector models, (2) evaluation of forecasting model accuracy, (3) evaluation of data available at NWCF Activity Groups and ASN (FM&C) for development of forecasting models or tools, (4) comparison of existing cash management results with forecasting results, (5) a summarization of possible applications of forecasting tools in the NWCF.

C. RESEARCH QUESTIONS

The following questions were addressed:

1. Primary:

Can forecasting models be used, or developed, to improve NWCF cash forecasts?

2. Secondary:

(1) What models are currently used to forecast cash balances in the NWCF Activity Groups and at ASN (FM&C)?

(2) Are private sector companies with similar business activities using effective cash forecasting techniques? Can such models be applied in the NWCF?

(3) How effective are existing models in forecasting cash balances?

(4) What requirements exist for forecasting cash balances at the ASN (FM&C) and Activity Group levels of the NWCF?

(5) Can forecasting tools be applied by NWCF AG's to more accurately develop budget plans?

(6) Can the data available to NWCF AG's be used to develop other statistical analyses (Statistical Process Control (SPC), moving averages, and decomposition) or new forecasting models?

D. SCOPE OF THESIS

Existing data were examined to assess model effectiveness and applicability to NWCF budgeting. Effectiveness was measured by comparing available historical figures with forecasts. Data were evaluated for trends and seasonality to determine if the system being evaluated could be modeled. Further, data were reviewed to determine if sufficient amounts were available for the types of models being considered.

E. METHODOLOGY

The methodology used included the following: (1) literature review of reports, instructions and existing models, (2) interviews with budget analysts at ASN (FM&C), Navy Supply Systems Command (NAVSUP) and American Management Systems, Inc. (which developed models for NAVSUP), (3) collection of historical data concerning

disbursements, collections, liquidated/unliquidated obligations and planned and actual NWCF budgetary figures, (4) evaluation of model in use at NAVSUP, (5) benchmarking of non-DoD cash forecasting models and techniques for possible DoD application, (6) assessing model(s) or statistical analysis applicability in NWCF cash management, (7) testing of collected data in model(s), and (8) analysis of results by comparison with actual budget figures and variances.

(1) Literature: A review of literature on existing models was completed, including government reports and instructions detailing WCF cash management procedures. Additionally, references were reviewed on forecasting models and statistical techniques to determine the range of possible models and/or techniques that may apply in NWCF cash management. This review also included research into the business practices at different budgetary levels in the NWCF in order to understand the forces that influence collections, obligations and disbursements in the different business areas.

(2) Interviews: Interviews were conducted with budget analysts at ASN (FM&C) and NAVSUP. Interviews focused on data sources, how information is used and what forecasting or statistical analysis tools are utilized, if any. Daily tasks were observed to determine if forecasting is feasible and beneficial from the viewpoint of the budget analyst. Interviews were also held with the cash managers at each level to discuss historic performance with respect to plans and goals. Attempts were made to interview financial managers of firms with business practices similar to the NWCF.

(3) Data Collection: Historical data concerning disbursements, collections, liquidated/unliquidated obligations and planned and actual NWCF budgetary figures were collected from resident databases at each interview site.

(4) Model Evaluation: NAVSUP's cash model was evaluated for effectiveness by reviewing historical performance data. Additionally, model documentation was reviewed to determine how the model functions and how variables affect forecasts.

(5) Benchmarking: Trade publications were reviewed to ascertain non-DoD efforts at business forecasting. Companies with industrial/supply business practices (e.g. Ingalls, Newport News, Boeing) were contacted to determine if they were utilizing forecasting tools. The literature review focused on government contractors and other manufacturing firms that use working capital to finance production and inventory functions.

(6) Model Application: Collected cash management data were reviewed to determine if the NAVSUP or other models identified could be used to improve cash forecasting in the NWCF. First, the data were evaluated for use in a forecasting model. Second, existing model effectiveness to accurately predict balances was assessed. Third, the candidate models were examined for applicability in the NWCF AG's. Further, statistical analysis tools were reviewed for application by budget analysts or activity comptrollers in developing budget submissions.

(7) Tests: Data collected at the interview sites were tested in the model(s) by comparing actual figures with forecasts to determine "goodness of fit". Variances were

analyzed to determine model effectiveness. The model was also evaluated on the value of the forecasts to budget analysts and cash managers.

II. OVERVIEW OF THE NAVY WORKING CAPITAL FUND

A. CONCEPTS AND HISTORY OF WORKING CAPITAL FUNDS

Working Capital Funds (WCFs) were originally established in DoD by the 1949 National Security Act Amendments. The legislation authorized the Secretary of Defense to utilize working capital funds to fund inventory procurement and industrial activities. WCFs can be broadly separated into two categories, industrial operations and supply operations. The primary goal of WCFs is to focus management attention on the total cost of carrying out DoD business functions. Focusing attention on costs is important, especially considering that the current WCFs are expected to generate about \$69 billion in revenue, while employing some 220,000 federal civilian employees and 24,000 military personnel [Department of the Navy (1997)]. The Navy WCF alone generated \$20 billion in 1997, while employing over 100,000 civilian employees and 3,000 military personnel.

In DoD, WCFs are used to finance the operating costs of supply, industrial and most service activities, by providing “up-front” funding for the costs of producing goods and services, and subsequently recouping that funding through customer reimbursement throughout the operating year (hence the term “revolving fund”). The WCFs are supposed to generate sufficient revenues over time to recover expenses and to operate on a break-even basis. Pricing is negotiated each year to generate a net operating result of zero. However, the Under Secretary of Defense (Comptroller) mandates that the funds

must maintain 7-10 working days of cash, and funds sufficient to support capital reinvestment programs [Department of Defense Office of the Under Secretary of Defense (Comptroller) (1997)]. Regardless of the cash requirement, fund pricing is estimated each year to cover expenses. A carry-over loss from the previous year will raise prices and rates, while a profit will decrease prices and rates.

1. Defense Business Operations Fund (DBOF)

Prior to 1991, the DoD WCFs were divided into four stock funds and five industrial funds. In late 1991, a new fund was established, combining all DoD stock and industrial funds, as well as several appropriated fund support activities into a single revolving fund called the Defense Business Operations Fund (DBOF). The concept of the DBOF was to focus leadership attention on the total costs of DoD business functions, and to promote active cost management in the revolving fund activities. The military services and defense components continued to be responsible for operating the business activities within the financial structure. However, Defense Management Review Decision 910 capitalized financial management and accounting functions into the Defense Accounting and Finance Service (DFAS), realigning disbursing and accounting personnel from the services into the new activity [General Accounting Office (1997), Report AIMD-97-152]. The transfer of accounting functions occurred during a period of significant downsizing throughout DoD, and the net effect was the loss of experienced finance and accounting personnel at the service level.

The Office of the Secretary of Defense (Comptroller) centrally managed the cash balance of the DBOF through fiscal year 1994. In February 1995, DoD returned management of DBOF cash to the services and DoD component level to align cash management accountability with those entities responsible for the business activities funded. DBOF further evolved or devolved in December 1996, when the Under Secretary of Defense (Comptroller) cancelled the DBOF and established four funds, the Army Working Capital Fund, the Navy Working Capital Fund (NWCF), the Air Force Working Capital Fund and the Defense-wide Working Capital Fund, collectively the Defense Working Capital Funds [Office of the Inspector General, Department of Defense (1998)].

2. Navy Working Capital Fund

The NWCF is used to finance and account for costs at Navy business-type activities, applying standard accounting principles as specified by the Federal Accounting Standards Advisory Board and the Office of Management and Budget. Like most revolving funds, the NWCF is designed to operate on a break-even basis over time, recovering current year losses or returning gains through subsequent year rate changes. In establishing the NWCF in 1996 the Navy included not only supply and industrial type activities in the NWCF, but also made several changes to the organization of activities in the fund. The changes included merging the Logistics Support Activity Group into the Supply Management Activity Group and transferring the Defense Printing Service to the Defense Logistics Agency [Department of the Navy (1997)].

The organization now includes six primary activity groups, with like business activities grouped together for financial reporting purposes. The activity groups represent nearly fifty NWCF activities with a revenue base of approximately \$20 billion annually, as shown in Figure 2.1. The larger activity groups include several secondary activity groups that closely align with Navy organizational structure. There are currently a total of seventeen activity groups, including a corporate level holding area for pending financial transactions at the Assistant Secretary of the Navy (Financial Management & Comptroller) (ASN (FM&C)). [Department of the Navy (1997)]

1998/1999 President's Budget

Supply Management	\$6.2B
Depot Maintenance	\$4.1B
Research and Development	\$6.0B
Transportation	\$1.1B
Information Services	\$0.2B
Base Support	\$1.8B

Figure 2.1 Navy Working Capital Fund Revenues

Supply

Supply Management – A primary activity group consisting of *two secondary activity groups*, Supply Management – Navy, and Supply Management – Marine Corps. The area encompasses inventory management for shipboard, aviation and amphibious repairable and consumable spare parts and commodities.

Industrial

Depot Maintenance – A primary activity group consisting of *four secondary activity groups*: Ordnance, Shipyards, Aviation and Marine Corps. The functions include maintenance, repair, manufacture, overhaul, refit and engineering services.

Services

Research and Development – A primary activity group consisting of *six secondary activity groups*: Air Warfare Center, Surface Warfare Center, Undersea Warfare Center, Command, Control and Ocean Surveillance Center, Naval Research Laboratory and Facilities Engineering Service Center. Functions include research, development, test, evaluation and engineering support functions.

Transportation – A primary activity group that provides Naval Fleet Auxiliary Force ships, Special Mission ships and Afloat Prepositioning Force ships for sea transportation, logistics and special missions.

Information Services – A primary activity group consisting of *three secondary activity groups* (DoN, DoD and Federal Agencies), which provide regional automated information services, and design, development and environmental support for information technology systems.

Base Support – A primary activity group consisting of nine Public Works Centers that support facilities maintenance, services and facilities.

3. Organizational Relationships

ASN (FM&C) maintains overall responsibility for the solvency of the NWCF, as the Program/Budget Office for the NWCF [Department of Defense Publication (1996)]. ASN (FM&C) develops budgets for the NWCF for submission to the Secretary of Defense by collecting and consolidating activity group budget estimates. Activity group managers develop their submissions by collecting and consolidating submissions from their activities. Activities prepare budget submissions by considering historical performance, anticipated workload and numerous other factors that may affect future year business. Correspondingly, when budgets are being executed in the current year, communication flows to and from ASN (FM&C), activity group managers and activities to ensure up to date budget information is maintained. Communication through this budgetary chain closely mirrors the actual chain of command as an activity (e.g. shipyard) reports to an activity group manager that is also the major claimant command (e.g. Naval Sea Systems Command), who in turn will report to the Program/Budget office (ASN (FM&C)). Figure 2.2 provides a partial illustration of how ASN (FM&C), activity group(s) (e.g. Supply Management Activity Group) and activities (e.g. Navy Inventory Control Point) appear in the NWCF organization for communicating budgetary information.

NWCF ORGANIZATION

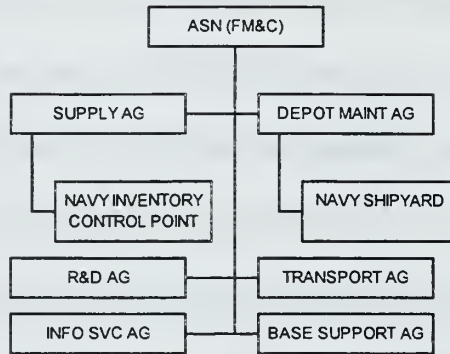


Figure 2.2 **Partial NWCF Budgetary Organization**

Communication continues frequently throughout the planning, programming, budgeting and execution phases of the Department of Defense budget cycle to facilitate budget estimate submissions, budget changes and the solution of execution problems. Figure 2.3 illustrates the data flow to and from the major entities in the NWCF budget. For example, in the case of the Fleet and Industrial Supply Center (FISC) Pearl Harbor, budget submissions are developed and forwarded to Naval Supply Systems Command (NAVSUP) as the Supply Activity Group manager. NAVSUP collects and consolidates submissions from activities in the group and forwards the consolidated submission to ASN (FM&C) for inclusion in the Secretary of Defense budget submission, and eventually the President's Budget. Likewise, when deviations from expected budget execution occur, ASN (FM&C) will contact activity group managers, who in turn will contact activities to determine the sources of deviation. The Defense Finance and Accounting Service (DFAS) is the clearing house for financial data from activities,

producing reports for all entities and helping to determine causes of deviations, posting errors or delayed processing [NAVCOMPTINST 7102.2 (1995)].

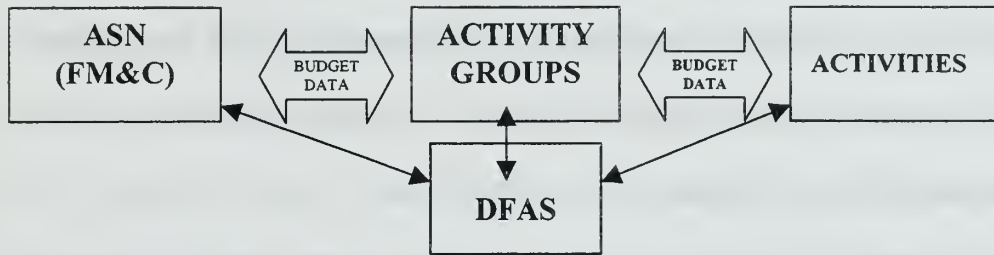


Figure 2.3 Flow of NWCF Budgetary Data

4. Definitions

The following are some of the more frequently used terms in NWCF budgeting.

a) Cash Management

Cash Management is the process by which managers maintain a sufficient supply of cash to meet day-to-day business needs and future investment plans. The process includes developing cash plans and monitoring execution, researching and reporting deviations from plan, and analyzing collections, disbursements and transfers affecting the cash balance. Effective cash management in the NWCF means maintaining 7-10 days of operating program disbursements plus six months of capital program disbursements. The cash requirements are levied by the Under Secretary of Defense (Comptroller) and are set to maintain solvency and prevent violations of the Anti-Deficiency Act. [Department of the Navy (1997)]

b) Outlays

Outlays in federal budgeting refer to the actual cash payments (including checks paid, electronic fund transfers, etc.) that occur in a fiscal year, basically what has been spent. The term “outlay” is congruous with “disbursement” and “expenditure”. Outlays, when compared with revenues from taxes and other sources are used to determine the federal deficit, or surplus, in a given fiscal year.

In *NWCF terms*, outlays additionally refer to the difference between disbursements and collections within the NWCF, as reported to the U. S. Treasury. A positive outlay indicates that more was disbursed than collected and results in a smaller cash balance in the NWCF. A negative outlay indicates collections were greater than disbursements and results in a larger cash balance in the NWCF. [Library of Congress (1991)] When outlays are discussed in this thesis, the NWCF definition of outlays applies.

c) Collections

Collections in a NWCF activity refer to revenues from sales of material or services (transportation, industrial work, repair, design, R&D). Collections can be from any entity authorized to be a NWCF customer, including private agencies, other federal agencies, other services or other NWCF activities. Most collections are made from non-NWCF Navy customers.

d) *Planning, Programming, and Budgeting System (PPBS)*

Originally implemented in DoD in the 1960s, PPBS establishes a scheduled framework for planning, programming and budgeting in all DoD programs. PPBS follows a strict timeline and calls for simultaneous development of short and long-term plans, while considering the effects of current execution. The net result of the multiple taskings required under PPBS is a well thought out and defensible budget. [Department of the Navy Program Information Center (1994)]

e) *Cash Balance*

Calculated on a monthly basis, the cash balance is determined by subtracting cumulative disbursements from cumulative collections and adding the surplus (or subtracting the deficit) to the previous month's cash balance brought forward. The cash balance becomes significant at the ASN (FM&C) and activity group level of the NWCF, as an aggregate 7-10 days cash must be maintained on hand to pay bills. Cash is most closely monitored at ASN (FM&C) (as the Program/Budget Office), and the cash balance is used to determine what action, if any, should be taken in advance billing customers (described below) to maintain solvency. [Department of Defense Publication (1996)]

f) *Advance Billing*

Advance billing refers to the practice of having customers pay for work or services agreed upon before the completion of work or delivery of service. Advance billing does not change the schedule of work to be accomplished, but it does increase the

short-term availability of cash. Advance billings are a carry-over from DBOF, which began large-scale advance billings in 1993. When the NWCF was established in 1996, an advance billing liability of \$2.2 billion was passed along, necessitating continued advance billing to the current day, although at a greatly reduced rate. Progress in reducing advance billing has been achieved largely by price increases used to generate additional cash. [Office of the Inspector General, Department of Defense (1998)]

5. Policy and Legal Requirements in the NWCF

a) 10 U. S. C. Section 2208: Working Capital Funds

The Secretary of Defense may require establishment of working capital funds to:

- (1) Finance inventories of supplies.
- (2) Provide working capital for industrial and commercial type activities that provide common services for the DoD. WCFs must be reimbursed, and regulations for costing and pricing shall be prescribed by the Secretary of Defense.

b) 10 U. S. C. Section 2216a: Defense Business Operations Fund

Specifies that charges (prices, rates) are set to recover full costs, including capital depreciation and the cost of the Defense Accounting and Finance Service.

c) 31 U. S. C. Section 1517: Antideficiency Act Violations

Specifies prohibited obligations and expenditures, in that an officer of the United States government may not make or authorize an expenditure or obligation exceeding an apportionment or an amount permitted by regulations under U. S. C. Section 1514(a). Penalties for violations include specific provisions for fines and imprisonment.

d) Defense Authorization Act for 1997:

Specifies amounts authorized for obligation and expenditure in fiscal year 1998, limits NWCF advance billing to \$1 billion (Section 371), and directs rate/surcharge revision to generate an additional \$5 billion in revenue.

B. BUDGETING IN THE NWCF

1. Cash Management

As discussed earlier, cash management is the process by which financial managers maintain a sufficient balance of cash on hand to meet day-to-day requirements and to support planned investment. The process includes, but is not limited to, developing cash plans, that is, anticipating month to month collections and disbursements; monitoring execution of the cash plans; and analyzing deviations from plan to determine causes. Accurate estimates of collections and disbursements and hence, outlays, are critical to avoiding a negative balance cash position, or a violation of the Antideficiency Act. Since 1993, the working capital funds, in all forms (DBOF, NWCF), have experienced a cash

shortage and have had to advance bill customers for work not yet performed. The NWCF cash managers have made headway in reducing the amount of the advance billing since assuming cash management responsibility from the Office of the Secretary of Defense in 1995. However, advance billing continues to be necessary to maintain a positive balance in the fund [Office of the Inspector General, Department of Defense (1998)].

a) *Cash Balances/Investment Capital*

Cash generated from the sale of goods or services is the primary means by which WCFs pay the bills. Cash balances are determined at the beginning of each year through many decisions and iterations during the budget process pertaining to workload levels, estimated costs, and setting prices to recover the estimated full cost of goods and services. Pricing is negotiated to result in a *net operating result of zero*, indicating that no profit or loss will be made from the sale of goods or services.

During the execution of the budget, the WCF should operate like a checking account, with collections having the effect of a deposit and disbursements (salaries, cost of operations, material purchases) the effect of a check issued. If budget estimates concerning collections and disbursements are accurate, the WCF cash balance should be sufficient to pay outstanding bills and to maintain capital investment programs.

b) *Customer Surcharges*

A surcharge is a “mark-up” to spare parts sold to customers, used to finance the cost of operating supply and repair depots. Customer surcharges are established for material furnished by a WCF activity on a *unit cost basis*. Surcharges are

computed for parts and material provided from supply activities by *estimating* the cost of goods sold for the following year and dividing by the *estimated* sales revenue. Surcharges are levied in the form of a mark-up percentage to the original cost of the material (FY 1997's material surcharge was 54 percent). The computation for surcharges includes factors for losses or gains from the previous year's operations.

c) Customer Rates

Rates represent the prices NWCF activities will charge customers for work performed or services rendered. Customer rates are established for services furnished by a WCF activity on a *unit cost basis*. Unit costs are set for non-supply (cost/units produced or services rendered) and depot-type activities (cost/direct labor hour). Rates are set by estimating next year's costs and dividing by next year's estimated workload.

Rates and surcharges are first negotiated with customers and then approved by the activities' major claimant. Setting rates and surcharges requires a definite focus on cost drivers, and the negotiation process requires active participation by buyers and sellers. Cost consciousness on the part of both parties leads to more efficient behavior, and customers can and often do seek cheaper alternatives [Office of the Inspector General, Department of Defense (1998)].

When rates are negotiated and forwarded, they are consolidated to establish a composite rate, and officially "set" in the President's Budget. Detailed rates are calculated at the activity/activity group level in the spring prior to execution and

approved by ASN (FM&C). Customer budgets are adjusted accordingly to reflect rate changes from the previous year, and are stable throughout the fiscal year.

d) Predicting Outlays

Predicting outlays is a function of predicting collections (revenues) and expenditures (expenses), as was stated earlier, in the NWCF, **Outlays = Collections – Expenditures**. Accurate outlay predictions are critical to the NWCF financial managers because they receive visibility at every level of the budget process, particularly at the top. In the Executive and Legislative branches of the federal government outlays directly affect the aggregate federal budget balance. [Library of Congress (1991)]

Predictions for future year collections and expenditures start at the lowest levels in the NWCF, the activities. In general, activities are provided control numbers from the activity group manager, authorizing an annual/quarterly rate of obligational authority. Activities, in turn will work within that set level, matching workload and schedules to set a monthly phasing of anticipated obligations. Likewise, the activities will estimate their monthly expenditures based on workload, schedule and other anticipated events and factors. Phasing plans for obligations and expenditures are negotiated with and approved by the activity group manager. Activity group managers consolidate activity plans for submission to ASN (FM&C), and adjust according to the various changes that may occur during the budget development process. [Department of the Navy Program Information Center (1994)]

Development of accurate budget plans is very difficult, as accounting anomalies, unstable workload and other environmental fluctuations are common in defense budgeting. Despite this fact, even minor deviations from plan must be explained, as small deviations in the large (\$20 billion annual) collections or expenditures plans can lead to seemingly large deviations in the relatively small (millions of \$) outlay plan. For example, suppose that ASN (FM&C) forecasts that in FY 1998 they will collect \$20 billion and disburse \$20.5 billion, for a planned outlay of \$500 million. Should actual collections fall short by \$200 million (a one percent deviation from plan), the actual outlay would increase to \$700 million, or a 40 percent increase from plan. In the example, ASN (FM&C) had developed a very accurate (99 percent) budget estimate, yet balanced budget watch dogs would be none too happy with the deviation from that estimate driving an additional \$200 million in unplanned outlays. As can be surmised, accurately predicting the budget picture is critical at all levels for financial managers in the NWCF.

1. Budget Formulation and Execution Process

Major players in the NWCF budget formulation and execution process are the congress, the Office of Management and Budget (OMB), the Office of the Secretary of Defense (OSD) Comptroller, ASN (FM&C), activity group managers and activities. Budgetary timelines in the NWCF follow the cycle established in the Planning, Programming, and Budgeting System (PPBS) for all DoD programs. Further complicating the budget development process is parallel sequencing of budget

formulation events with the Program Objectives Memorandum (POM) development. Whereas budget formulation focuses on the next two budget execution years, POM provides a six year intermediate range plan within the Future Years Defense Plan (FYDP). POM and the FYDP will not be discussed in detail. Of significance is the overlap of dates and deadlines with the budget formulation, POM development and execution of the current year's budget. As a revolving fund, the NWCF focus is less on the program, and more on the rates and surcharges involved and the expected outlays. Submission dates do not differ from appropriated programs and are illustrated in Figure 2.4 below. Note that in May 1998, NWCF financial managers were preparing POM submissions (FYs 00-05), budget submissions (FYs 00-01), executing the FY 98 budget and preparing to execute the FY 99 budget, which commenced 1 Oct 98. Recall from earlier discussion that each block shown in Figure 2.4 represents multiple steps of submission, budget mark-up and reclama. [Department of the Navy Program Information Center (1994)]

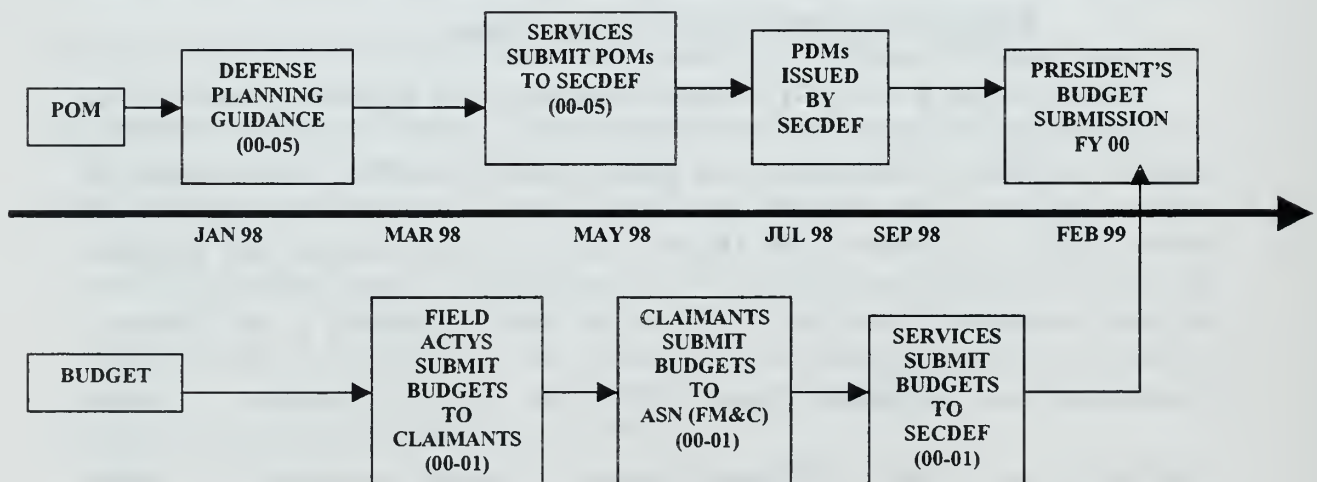


Figure 2.4 Sample POM and Budget Submission Timelines

a) Activities

Activity budgets are submitted in the March to May timeframe to activity group managers. NWCF activities may be simultaneously submitting budgets for multiple appropriations in addition to their WCF submission. The submissions are based on historical performance and current data, and on the best estimates of the activities' managers

As stated earlier, the budgetary focus at the activity level is the development of customer rates, followed by a predicted phasing of collections and expenditures. Each rate includes different costs that can be either directly or indirectly applied to the service or material being provided. Rates are in turn approved by activity group managers and subsequently used to develop the budget plan. In recent years, rates have been difficult to stabilize and accurately predict due to infrastructure downsizing. NWCF activities have experienced difficulties predicting workload from their declining customer bases and the resultant overcapacity. The net result has frequently been lower than expected collections, which has resulted in higher rates in the next year to recover less than expected earnings. The so-called "death spiral" of demand has ensued. That is, when rates go up, customers use less, driving business even lower in many areas. The negative effects of inaccurate budget forecasts have been nearly universal in the NWCF and have caused problems in maintaining adequate cash balances at the ASN (FM&C) level. [General Accounting Office (1997)]

b) Activity Group Managers

The ASN (FM&C) Budget Review schedule controls the budget process.

Figure 2.5 illustrates the event timeline.

• APR-MAY	BUDGET GUIDANCE ISSUED
• MAY-JUL	EXHIBITS PREPARED AND SUBMITTED
• JUL-AUG	EXHIBITS REVIEWED AND ANALYZED
	HEARINGS ARE CONDUCTED
	MARKS (ADJUSTMENTS) ARE RECOMMENDED
	RECLAMAS (APPEALS) ARE SUBMITTED
• AUG	DECISIONS ARE MADE
• SEP	DoN BUDGET SUBMITTED TO OSD

Figure 2.5 ASN (FM&C) Budget Review Schedule

Activity group managers work closely with ASN (FM&C) budget analysts to establish the baselines for pricing and rate setting. Material surcharges and rates are set to achieve a Net Operating Result (NOR) of zero in a budget year. Activity group managers prepare an operating budget and a capital budget. The operating budget represents the annual operating costs of the activities, including depreciation expense, and identifies projected collections, expenditures, the NOR, performance indicators, civilian and military requirements, unit costs and customer rates. Methods of forecasting vary as well, from simple consolidation of activity inputs to running mathematical models to predict collections and expenditures. Collections and expenditures are formulated based on projected workload and the expected costs to accomplish that workload in a cost-effective manner. The capital budget forecast represents the resources required to buy capital assets or to improve existing assets to become more efficient. In general, the

activity group managers' inputs are accepted with few changes from ASN (FM&C) and eventually become part of the President's Budget. It should be noted that forecasted budgets can be and often are changed just prior to the President's Budget submission in February, to reflect events and new information that developed subsequent to the OSD submission [Department of the Navy Program Information Center (1994)].

c) ASN (FM&C)

ASN (FM&C), in addition to managing the DoN's budget submission schedule, also participates in the OSD/OMB Budget Review. The event schedule is depicted in Figure 2.6.

• AUG	BUDGET GUIDANCE ISSUED
• SEP	EXHIBITS PREPARED AND SUBMITTED
• SEP-OCT	EXHIBITS REVIEWED AND ANALYZED
	HEARINGS ARE CONDUCTED
• OCT-DEC	PROGRAM BUDGET DECISIONS (PBDs) ARE ISSUED
	RECLAMAS ARE SUBMITTED AND REVIEWED
• NOV-DEC	DECISIONS ARE MADE
	MAJOR BUDGET ISSUES (MBI) MEETINGS ARE HELD TO
	RESOLVE OUTSTANDING ISSUES
• DEC	SECDEF DISCUSSION WITH PRESIDENT
• FEB	PRESIDENT'S BUDGET SUBMITTED TO CONGRESS

Figure 2.6 OSD Budget Review Schedule

In addition to the myriad budget reviews, submissions and responses, ASN (FM&C) is also closely monitoring the current year's budget execution, each month receiving the previous month's performance data from DFAS, and preparing and analyzing reports to determine performance in relation to last year's budget forecasts. The flow of information concerning execution deviations mirrors the flow described above in the budget development process [NAVCOMPTINST 7102.2 (1995)].

C. CURRENT STATUS OF NWCF CASH MANAGEMENT

The congress and the General Accounting Office (GAO) have watched the development of the working capital funds with great interest. In a period of steeply declining budgets, the \$20 billion in collections and disbursements in the NWCF has

become an object of significant scrutiny, especially when the fund can cause unanticipated outlays that affect the balance of the federal budget. Additional interest is piqued when the funds are not performing according to plan, and when significant price and rate increases become necessary to cover losses. Although the NWCF does not involve new appropriation of funds by congress, the rate and price increases require that the budgets of appropriated fund activities (NWCF customers) be “plussed up” so they can afford the increases.

As interest has arisen, the NWCF and other defense working capital funds have been frequently audited by the GAO on various issues (see Figure 2.9), from cash management to preparation of financial statements. Additionally, the defense WCFs were directed by the congress (Section 363 of the National Defense Authorization Act for FY 97) to develop and submit an improvement plan for revolving fund business operations by September 30, 1997 [Department of Defense Office of the Under Secretary of Defense (Comptroller) (1997)]. Specific areas targeted for improvement were Accounting Policies, Systems and Practices; Cash Management, Setting Prices, Surcharges and Agreements; and Stabilized Rates. This report requirement highlights the congress’ major concerns with the WCFs. Recent performance in cash management forecasts is illustrated in Figures 2.7 and 2.8.

FY 97 DoN NWCF Cash

FY 98 Pres Bud Plan vs Actual/FY 99 OSD Submit

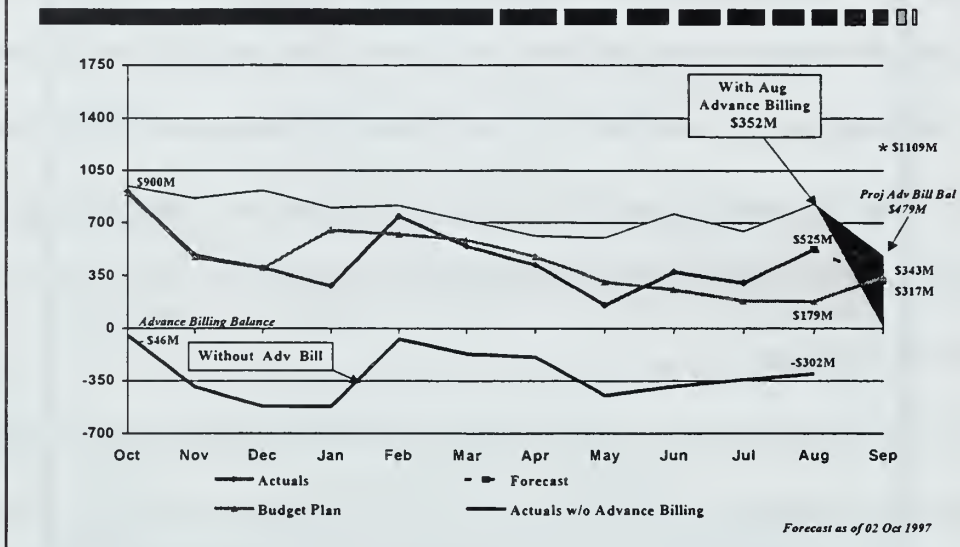


Figure 2.7 FY 1997 DoN NWCF Cash Track

FY 98 DoN NWCF Cash

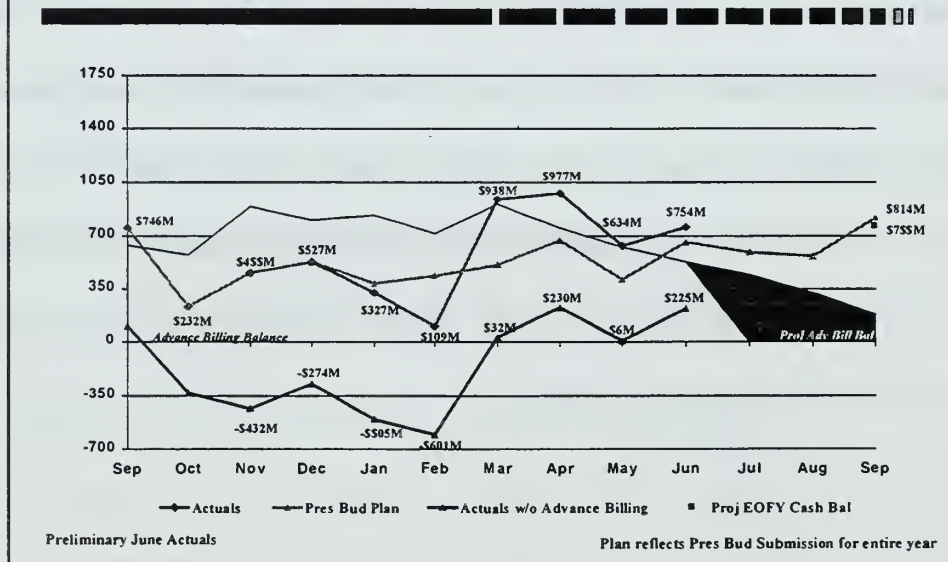


Figure 2.8 FY 1998 DoN NWCF Cash Track

As Figures 2.7 and 2.8 illustrate, without advance billing, the NWCF's cash position would have been negative from the inception of the fund until the middle of fiscal year 1998. The fund has remained solvent by advance billing customers for work not yet performed, a practice that the congress has directed to be terminated by the end of fiscal year 1998.

1. Audits and Reports

Figure 2.9 lists reports and audits issued concerning cash management in the working capital funds.

General Accounting Office	
Report AIMD-98-039	Cash Management in the Defense Working Capital Funds
Report AIMD-97-221	DoD Faces Continued Challenges in Eliminating Advance Billing
Report AIMD-97-152	Challenges Facing DoD in Managing Working Capital Funds
Report AIMD-94-80	Financial Management: Status of the Defense Business Operations Fund
Inspector General	
Report No. 97-067	Defense Agencies Cash Management in the Defense Business Operations Fund
Report No. 96-178	Internal Controls and Compliance with Laws and Regulations for
Defense Business Operations Fund Consolidated Financial Statements for FY 1995	
Department of Defense Office of the Under Secretary of Defense (Comptroller)	
September 1997	A Plan to Improve the Management and Performance of the Defense Working Capital Funds

Figure 2.9 Audits and Reports on Cash Management

2. Initiatives

The managers of the NWCF have taken steps at all levels to improve performance, efficiency and accuracy in reporting. Consider the initiatives taken to improve cash management, specifically in the area of budget forecasting.

Since 1995, the NWCF has worked off nearly \$2 billion in advance billing, achieving a positive balance in the fund in mid-1998. The DBOF, then the NWCF had carried advance billings to remain solvent since 1993. ASN (FM&C) continues efforts to develop an automated cash model to improve activity reporting capabilities and cash management reporting. In a primarily “grass-roots” approach, the ASN (FM&C) personnel have identified requirements, scrubbed data inputs and developed a working prototype cash model in a one year time period. The model is already being used to produce reports and to allow activities to submit budgets electronically. Efforts are being made to actively convert raw financial data into a usable format to determine cash balances in a more accurate and timely fashion [Office of the Inspector General, Department of Defense (1998)].

Activity group managers have also made headway in improving accuracy in cash balance forecasting. For example, the Naval Supply Systems Command has developed and implemented cash models at two major contracting activities, the Naval Inventory Control Point, Mechanicsburg, PA and the Naval Inventory Control Point, Philadelphia, PA. In addition, NAVSUP has completed an extensive revision of its cash forecasting model to provide better predictions of collections and expenditures.

Numerous other efforts at promoting level loading workload, reducing contracting lead-times and reporting financial data are underway at NWCF activities, activity groups and at DFAS. A Supply Management activity group tiger team has proposed changes to rate structures that may affect all NWCF activity groups by reducing rates and

surcharges. All efforts are focused on reducing costs and providing a clearer picture of what the costs are and what they will be. Within the scope of this thesis, the focus is on improvements in cash management forecasting techniques, specifically, employing modeling and other forecasting methods to enhance decision-making ability. The next chapter will provide background concerning the development and utilization of financial forecasting methods and models.

III. FINANCIAL FORECASTING AND MODELING

Forecasting and modeling have long been employed in organizations of all types, and commitment to forecasting as an aid to decision making has increased steadily since the early 1960s [Wheelwright, S. C. and Makridakis, S. (1985)]. Webster's dictionary defines a model as "a description or analogy used to help visualize something that cannot be directly observed", and "a system of postulates, data and inferences presented as a mathematical description of an entity or a state of affairs." In the case of modeling for forecasting purposes, the model is a construct of the important features of the system being modeled, simplifying the system and making it more easily manipulated. Such a model can be said to *simulate* a system. According to *Webster's Dictionary*, to simulate is "to assume the appearance without the reality". Variables in a simulated system (i.e. model) can be changed to determine what effect, if any, the change will cause in the future.

A *forecasting* model becomes a decision-making aid for managers: it attempts to create a simplified version of reality, including only the most critical factors, while excluding those which are not. The essence of model building is this process of simplification, or "stripping away" to concentrate on the essential elements of a system [Levenbach, H. & Cleary, J. P. (1984)]. Models permit the forecaster to predict the effects of future events or trends, although the simplified version of the system cannot account for all factors, such as human behavior and unanticipated events or system

changes. This is the trade off – simplicity for completeness. No forecast model will ever be 100 percent accurate; rather the model becomes another useful tool in the decision makers kit.

A. MODELS AND SIMULATION

As discussed above, by simulating a system, an analyst can try to determine the effects of decisions and environmental changes without actually dealing with “live” consequences. Simulation can be thought of as inexpensive, as opposed to experimenting with reality, which can be expensive in terms of resources and consequences. This economical feature has helped make simulation increasingly popular with managers when dealing with uncertainty in decision-making. Simulation permits the experimental testing of hypothetical conditions that do not yet exist. With simulation, managers can manipulate variables (the ‘what-if’ question) to determine the effect those changes (or decisions) will have over a period of time. There are two approaches to simulation that will be discussed in this thesis, *deterministic* and *probabilistic*.

1. Deterministic Simulation

The basis for this type of simulation is that there is a single value estimate for each variable (e.g. collections will be \$19 billion). This approach enables the decision-maker to employ various mathematical methods in various decision areas. In a deterministic simulation, anyone who follows the rules set forth in the simulation setup

should arrive at the given answer, although the answer is unknown until after the simulation is completed [Liao, S. S. (1998)].

2. Probabilistic Simulation

This approach applies a range of probable outcomes from simulation, based on input variables that have a range of possibilities. Variables in this approach appear as a range of values (e.g. collections will be \$18 - \$20 billion), vice a single, or deterministic, value. Likewise, the model will produce a range of outcomes, with associated levels of confidence (e.g. there is a 95 percent probability that outlays will be between \$200 to \$300 million). A probabilistic simulation recognizes that the data used as the basis for the model are less than precise. Even the most sophisticated of models is often based on data with varying degrees of reliability – basically, *uncertainty*.

3. Building Probabilistic Variables in a Model

Various types of models and methods appropriate for business forecasting are discussed in detail in the sections that follow. This section addresses the probabilistic nature of variables that are used in constructing business forecasting models. The steps to building probabilistic and deterministic model are identical, except that variables involving uncertainty (i.e. a range of possible values) will require an assessment of their possible outcomes and associated probabilities. For example, historically, collections for January have been \$230 million or lower 20 percent of the time and between \$231 and \$250 million 80 percent of the time. This range, with associated probabilities, establishes

a distribution of possible values for the variable “collections”. Similar distributions can be created for other uncertain variables, including growth or decline in interest rates.

B. BUSINESS FORECASTING MODELS

Forecasting involves all fields of business management, from finance to marketing, production, budgeting and operations, to name a few. Business forecasting can be broken down into three distinct categories.

4. Judgmental Forecasting

Judgments are individual or group decisions and the vast majority of forecasting decisions are addressed through judgmental methods [Wheelwright, S. C. and Makridakis, S. (1985)]. Nearly every manager employs subjective forecasting every day. This is the intuitive approach, the seat-of-the-pants effort to make a good short-term response. In many cases, this intuitive approach may be more reliable than any mathematical function. This is the basic premise of most forecasts: inputs to a system generate outputs. What the judgmental forecaster does is try and determine what happens in the system, either from personal knowledge about the system, or through a group discussion and analysis of the system. In all cases, the system is kind of a “black box”, as shown in Figure 3.1, and the reliability of the forecast is based on the record of forecasts versus actual occurrences over a period of time. [Nelson, C. R. (1973)]

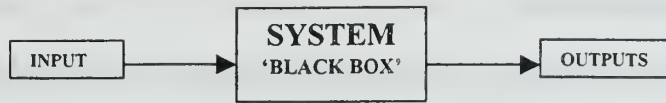


Figure 3.1 **Concept of Forecast Models**

2. **Quantitative Forecasting**

There are three sub-categories of quantitative forecasting:

a) Time-Series Methods

Time-series methods attempt to identify patterns in data using time as a reference. The forecast is then based on the identified patterns through extrapolation.

b) Explanatory Methods

Explanatory methods seek to identify the causal relationships between variables that led to the outcomes observed. Forecasts are made by applying those relationships to the future.

c) Monitoring Methods

Monitoring methods identify changes in patterns and relationships. This method is used when extrapolation of past patterns or relationships is not appropriate.

3. **Technological Forecasting**

Technological forecasting is used to address long-term technological, societal, economic or political issues. There are two subcategories:

a) *Extrapolative*

Extrapolative forecasts use historical patterns and relationships as a basis for predictions.

b) *Normative*

Normative forecasts use objectives, goals and desired outcomes as a basis for forecasting, thereby influencing future events. [Wheelwright, S. C. and Makridakis, S. (1985)]

Appendix A provides a comprehensive table of forecasting approaches, methods and techniques. As described above, selecting an approach that is appropriate for the system being forecast is critical. In addition, an intimate knowledge of the system's functions and relationships, as well as extensive analysis of available data, is essential for successful forecasting.

C. CHOOSING THE APPROPRIATE FORECASTING METHOD

NWCF cash management budget data consist primarily of *collections*, *disbursements*, *outlays* and *cash balances*. As discussed in Chapter I, the simplified equations for NWCF cash management are:

$$\text{Collections} - \text{Disbursements} = \text{Outlays (+/-)} \quad (\text{Equation 1})$$

and

$$\text{Beginning cash balance} + \text{Outlays (+/-)} = \text{Ending cash balance} \quad (\text{Equation 2})$$

A further review of the historical data used to develop budget submissions shows that the quantity of collections and disbursements is relative to time; that is, collections and disbursements accumulate over the course of the fiscal year. Using the table in Appendix A, consider the *Quantitative* approaches to forecasting. Quantitative forecasts, as mentioned earlier, are appropriate for quantitative data. Options can be narrowed further by considering the types of quantitative methods available. Consider the possibility that, while several methods may be appropriate, some forecasting methods are better suited for different variables within the NWCF budget data. [Wheelwright, S. C. and Makridakis, S. (1985)]

3. Time-Series Methods

A time-series consists of chronologically ordered observations from a particular system. The assumption is that there exists a pattern that is a function of time. Appendix A provides a list of common time-series methods, with brief descriptions. *Time-series* methods assume that history repeats itself and that the future will be some kind of continuation of the past. Forecasts are obtained on the basis of past values over a period of time.

Time-series analysis involves breaking down (decomposing) data patterns into sub-patterns that reflect the different forces that are at work within a system. The sub-patterns include the following:

Long term trends: Trends can be increasing, decreasing or unchanged. An example is the growth of population over time. The trend is a steady upward slope when population is graphed as a function of time.

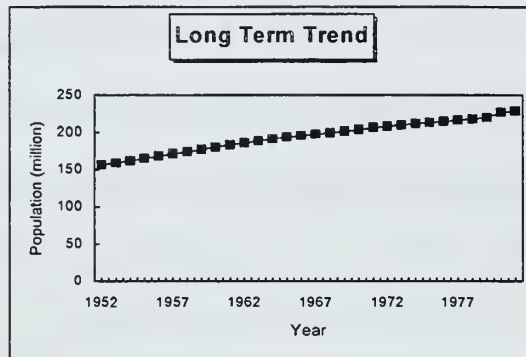


Figure 3.2 Long Term Trend

Seasonal variation: A time-series exhibits a seasonal pattern if the variable changes according to a seasonal pattern. An example is the average monthly temperature in a geographic location. When temperature is plotted against time, a seasonal pattern is revealed that repeats itself every twelve months. The seasonal factor reflects periodic fluctuations of *constant length*, and may be due to weather, holidays, quarterly accounting or many other factors.

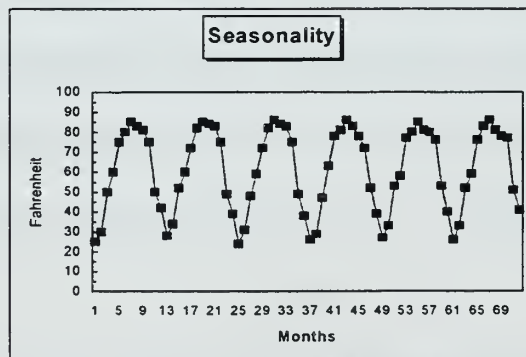


Figure 3.3 Seasonal Trend

Cyclical variation: In this case there is no obvious pattern as noted with seasonality. Cyclical factors often represent the ups and downs of the economy or interest rates. Cyclic patterns differ from seasonality in that cyclic fluctuations are not necessarily of a constant length.

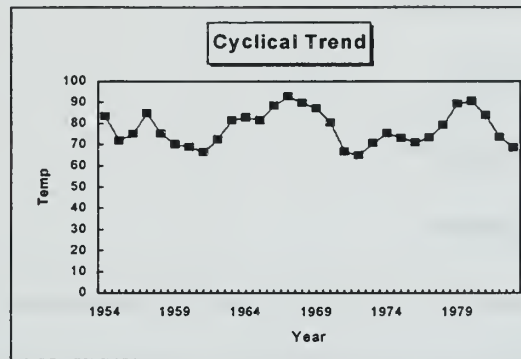


Figure 3.4 Cyclical Trend

Random deviation: In this case there is no discernable pattern whatsoever when the variable is graphed over a period of time. An element of randomness or error is always present in a time-series, regardless of the presence or absence of the three aforementioned patterns. [Liao, S. S. (1998)]

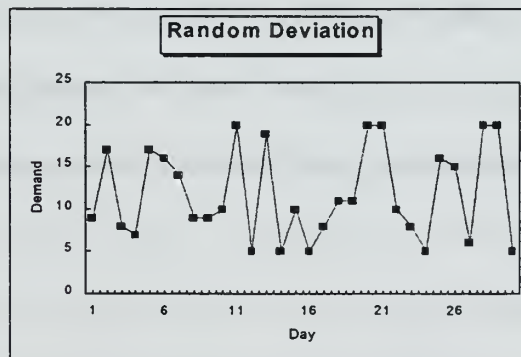


Figure 3.5 Random Pattern

A time-series can be composed of any combination of the above patterns (see Appendix B, Figure 5), and hence the expression

$$Y = T * S * C * R \quad (\text{Equation 3})$$

where **Y** is the variable of interest and

T = long term trend

S = seasonality

C = cyclical pattern

R = randomness

In this fashion, when any or all of the patterns are present in a time-series data set, each can be expressed by some mathematical equation that is representative of the patterns present. When patterns are present in a time-series, it is necessary to break the patterns out using *decomposition*.

a) *Decomposition*

Decomposition separates the patterns by removing patterns one at a time, thus enabling each pattern to be mathematically modeled separately. Cyclical and random effects are not readily susceptible to analysis by decomposition. As such, methods for analysis by decomposition have been developed only for long-term trends and seasonality. To isolate the trend pattern *a ratio to moving averages* is used.

<u>Period (t)</u>	<u>Value (Y)</u>	Centered Moving
		<u>Average (M_t)</u>
1	5	-
2	7	7
3	9	7
4	5	7
5	7	7
6	9	7
7	5	7
8	7	7
9	9	-

Figure 3.6 **Centered Moving Averages Table**

Figure 3.6 illustrates how a centered moving average removes the highs and lows by averaging. In this time-series note that the period of seasonality is three periods. By centering a moving average on each of the three periods, the seasonal variation is completely removed, leaving only a trend line. In this example, the trend line is $Y = 7$. Plotted on a graph it would be a flat line with a y-intercept of 7. Should a trend line with a slope be revealed, a linear equation for that trend line can be derived using *simple regression*, discussed in the next section.

The seasonal pattern is represented by a *seasonal index*, computed for each observation within a seasonal period. Computation of the seasonal index for each observation (i.e. months in a twelve month period) is accomplished by first computing an *actual-to-moving average* ratio for each observation. The mean for these ratios is next

computed for all “matching” observations in the data set (e.g. average all the January observations). This mean is the seasonal index.

Subsequent to the modeling of the trend line and development of the seasonal index, both elements are combined in the original equation.

$$Y = T * S * C * R$$

Thus the time-series is represented by a single mathematical equation. In the examples provided in Appendix B, the trend and seasonal patterns can be isolated (assuming away the random and cyclic patterns as insignificant) and a seasonal index for each month and an equation (model) representative of the trend line can be computed. The variable of interest can be forecasted for any period from the base period using the model. [Liao, S. S. (1998)]

4. Explanatory Methods

Explanatory methods are based on the premise that the future can be predicted by understanding the factors that explain why the variable of interest changes. Developing an explanatory or causal model makes the system more understandable and allows the forecaster to experiment with different combinations of inputs to study their effects on the forecasts. Forecasts are based on relationships with other variables.

To narrow the approach to a specific forecast method, a further review of the data from the system being forecasted is required. Several explanatory methods may work, but which method will provide the most accurate and reliable forecasts? In the case of the NWCF cash management budget system, the *regression* method becomes the logical

choice, as variations in the variable to be forecasted can be explained by variations in another variable (see equations 1 and 2).

a) *Simple Regression Methods*

As discussed above, the regression method of forecasting expresses the functional interdependence of variables in a model. The forecast is expressed as a function of a certain number of factors or variables that determine its outcome. Such forecasts can be, but are not necessarily, time-dependent. Regression is concerned with the problem of estimating the value of one variable, called the *dependent variable*, on the basis of one or more variables, called the *explanatory* or *independent variables*.

b) *The Simple Regression Model*

In simple regression, the dependent variable is annotated by the letter **Y**, and a single independent variable by the letter **X**. Figure 3.7 illustrates the dependent variable (Y) plotted against the independent variable (X), with the dots representing actual observations and the solid line representing a linear equation “model” developed by regression.

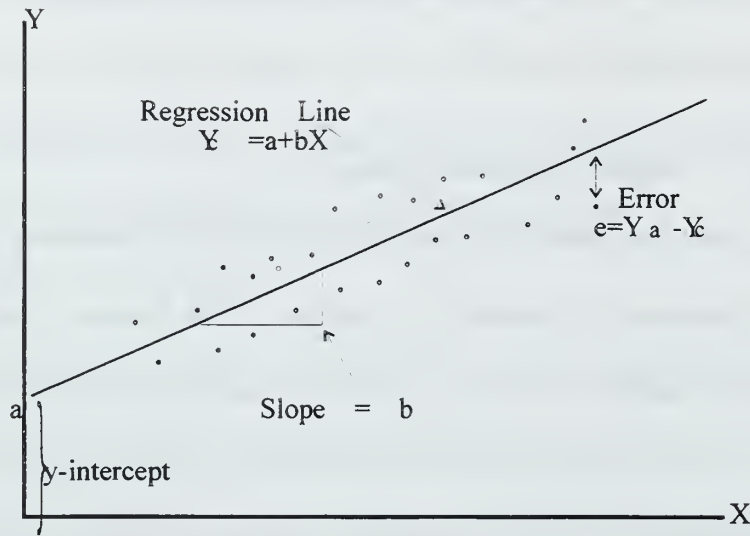


Figure 3.7 The Simple Regression Model

Regression allows us to express the relationship between Y and X algebraically, with the model describing the expected average value Y_c , given a specific value of X . The algebraic model can be expressed as Equation 4 (see below). In Figure 3.7, Y_a represents the actual Y observed (i.e. the plotted points), and the difference between Y_c (i.e. the regression line) and Y_a is the *error*, e , as illustrated in Equation 5. In the Figure, a represents the Y -axis intercept, or the value of Y when $X = 0$. Additionally, the slope of the regression line is represented by b . The objective of regression is to determine the equation (Equation 4) that minimizes the error term (Equation 5), thus best describing the actual relationship in algebraic terms [Liao, S. S. (1998)].

$$Y_c = a + bX \quad \text{(Equation 4)}$$

$$e = Y_a - Y_c \quad \text{(Equation 5)}$$

c) *Least Squares Method and Software Regression Analysis*

The least squares method is a common method used to develop a regression line that minimizes the sum of the squared error terms e (equation 4), more so than any other straight line that could be fitted through the observations. For the purpose of this thesis, the least squares method will be discussed only as it is applied using statistical software. Most spreadsheet-type software has the statistical capability to perform regression. The software automatically calculates a regression line employing the least squares method. A sample output is provided in Figure 3.8.

SUMMARY OUTPUT								
<i>Regression Statistics</i>								
Multiple R	0.988989709							
R Square	0.978100644							
Adjusted R Square	0.977345494							
Standard Error	0.729524553							
Observations	31							

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	-0.553181102	0.268524373	-2.0601	0.048465	-1.10237541	-0.00398679	-1.102375409	-0.003986795
X Variable 1	0.527216719	0.014649206	35.989	1.28E-25	0.497255713	0.55717772	0.497255713	0.557177725

Figure 3.8 Sample Regression Output

The output in Figure 3.8 was produced using *Microsoft Excel*, based on a dependent variable being regressed on one independent variable (in this case time). Of note is the R Square statistic, which represents the relationship between the two variables, and the strength of that relationship. In this case the relationship seems strong at nearly 98 percent.

The Intercept is the y-intercept **a**. The X Variable represents the slope of the regression line **b**. The t-statistic provides an indicator of the statistical significance of the coefficient terms. A general rule of thumb is that, unless the sample size is very small

(i.e. ten or less), a t-statistic should be at least two for the coefficient to be considered significant. A variable with an insignificant t-statistic can be removed from the model. The equation for the regression line is:

$$Y_c = (-0.553) + 0.527X$$

If an X value is inserted (time in months from the base period), the Y value can be predicted at that point. Figure 3.9 graphically illustrates the regression model, as plotted against the actual observed data.

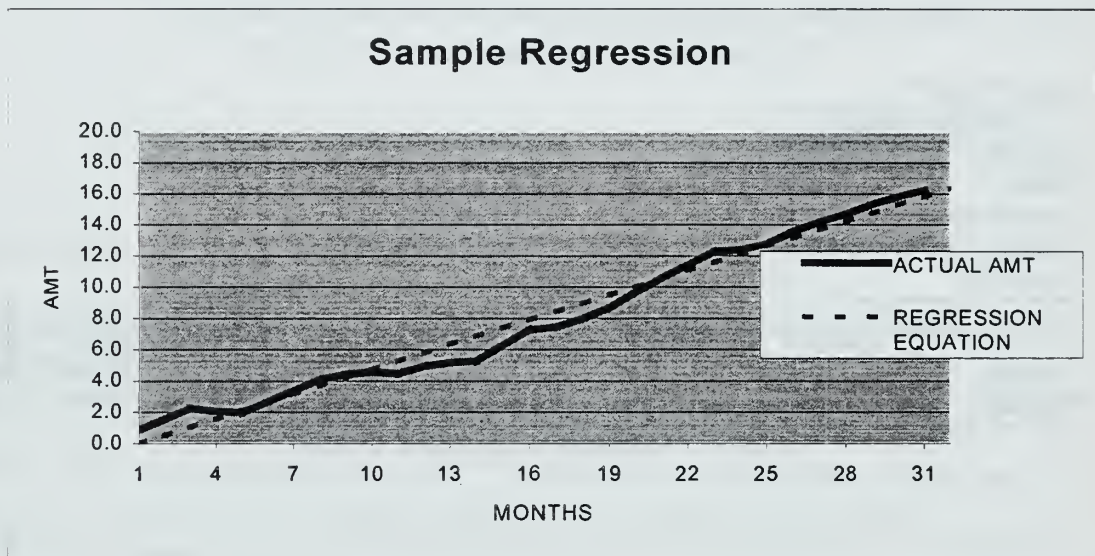


Figure 3.9 Sample Regression Graph

In Figure 3.9, the solid line represents the actual observations, and the broken line, the regression line. While the fit is not perfect, it is 98 percent (R-Square) accurate.

3. Developing a Forecast

When the simplified model has been constructed, a forecast can be developed. The model permits the forecaster to estimate the effects of future events or trends. From the above discussion of model building and forecasting techniques, a real-life system can

be reduced to a mathematical equation. A model can be developed by using historical, actual data from the system. The model can now be used to forecast future output from the system. The forecast can now aid in the decision making process.

6. Using the Forecast Model

A general process for using a forecast model should include, from start to finish:

- Find and verify the sources of the data to be forecast.
- Obtain information about external conditions; that is, factors in the environment that may influence the forecast.
- Determine the needs of the user of the forecast.
- Gather the human and financial resources required to produce a forecast.
- List the projection techniques.
- Format the output of the final product
- Present the forecast to the users.
- Evaluate the forecast on an ongoing basis.

The above steps are not all-inclusive, but provide a framework for developing and maintaining a reliable forecast model. [Levenbach, H. & Cleary, J. P. (1984)]

D. INDUSTRY PRACTICES

Business forecasting has been practiced for literally thousands of years – if Joseph's Old Testament prophesy about the seven good years and the seven lean years is considered to be a forecasting exercise. Joseph's prediction was accurate and his boss,

the Pharaoh, rewarded him handsomely for the effort. [Butler, W. F., Kavesh, R. A., Platt, R. B. (1974)]

Since Joseph's time forecasting has come a long way. Significant improvements in procedures occurred following the Great Depression and further improvements have been made with the advent of the computer. The development of the personal computer, spreadsheets and statistical software in the 1980's created a virtual explosion in business forecasting popularity. Today's business managers rely increasingly on the concepts and methodology of statistics and econometrics in day-to-day problem solving. Specifically, today's managers forecast expenses and revenues, sales and inventory volumes, construction and equipment outlays, domestic and international economic trends, regional and government expenditures, monetary policy and stock market trends, and profits, to name a few.

1. Literature Review

There are many excellent references available that provide detailed methods for all manner of business modeling and forecasting. Considering the aforementioned increase in employment of forecasting and modeling, the references are rich in content concerning particular methods that could be applied in particular situations. For example, one author provides specifics for a model developed for forecasting short and long-term defense expenditures, using regression analysis on the relationship between Gross National Product and military spending. Of interest is that the models were developed in the early 1960s [Butler, W. F., Kavesh, R. A., Platt, R. B. (1974)]. Although much of the

published literature on business forecasting and modeling is dated, the principle and methods remain timely and accurate. The difference today is that the previously complex calculations associated with modeling and simulation are now greatly simplified by the use of statistical software and personal computers.

a) *Cash Management and Forecasting in Private Industry*

Cash management has received increasing attention in private-sector industry for many of the same reasons for the increased focus on cash management in the defense WCFs. Changes in the economic and business environment have forced companies to elevate their cash consciousness [Bennett, D. & Eklund, D. (1994)]. Operations, sales and demand for working capital are fluctuating erratically at many companies, increasing the need to understand and forecast the impacts of the fluctuations create cash positions. Industry has found that the more decentralized and geographically dispersed an organization is, the more complex its forecasting process becomes.

For private firms, cash forecasting becomes more important as cash flows dwindle. Conversely, cash forecasting is often a less important management tool for companies that enjoy strong, positive cash flows. In all cases, a clear definition of management's objectives and purposes for forecasting will facilitate the development of an effective forecasting model [Bennett, D. & Eklund, D. (1994)]. *Corporate Cashflow* recommends activities should first determine:

- Who is responsible for the forecast, the treasury department or operating units?
- How frequently should cash be forecasted – quarterly, weekly or daily?

- What period should the forecast cover – calendar year, fiscal year or rolling 12 months?
- How much tolerance for error exists? Plus or minus X percent?
- How urgent is the forecast? Immediate, or in six months?
- How is the data gathered – manually or automatically?
- Is a model needed? Perfect forecasts require perfect knowledge of the company's operations and functional relationships. While difficult to model, simplified representations of the system are reasonably accurate and beneficial.

b) Industry Cash Forecasting Programs

Industry journals on cash forecasting emphasize cash flow information on a number of management levels. The amount of integration and automation depend on the company's needs, personnel and computer resources. Common elements to a good forecasting program are:

- Identifying forecast objectives: The goal of forecasting is to obtain better decision making – in liquidity management, financial control (by providing standards of measurement for comparison with actual cash flows) and capital budgeting (to evaluate project viability).

- Building the information network: It is important to bring together all potential contributors and users of the forecast information. A forecast is only as good as the information it contains. An industry cash forecast network would include personnel from:

- * sales and marketing
- * customer service/accounts receivable

- * purchasing/accounts payable

- * payroll, tax and legal

- * corporate finance/cash management and senior management

- Define the cash flow components: Industry practice is to include only those items that result in transactions through external bank accounts (excluding raw materials, inventory and depreciation). The forecasts are usually set up in the standard format of opening balance, cash in, cash out and closing balance format.

- Establish the forecast method: Most firms find that a simple program using *Excel* or *Lotus* type spreadsheet templates can be implemented with little cost and training required. More sophisticated programs involve extrapolative mathematical models, including *simple or weighted moving averages, simple regression or a distribution model*. [Sidford, C. (1997)]

- Analysis, performance and benchmarking: The forecast tool must be continually updated. Users of the information must also be provided variance reports to facilitate analysis of the differences between forecasted and actual results. Targets and/or benchmarks must relate to the objectives of the forecast – if an objective is minimizing funding costs, targets should be geared towards achieving minimum variances from forecasts.

An effectively implemented and maintained forecast program allows firms to conduct sensitivity analysis to determine how changes in cash flow occur, and how those changes will impact the company's results. Even relatively simple models allow

parameters to be changed (increasing or decreasing sales) and recalculation of future cash balances. For industry the on-going forecast program additionally becomes the basis for building budgets, through analysis of historical information. Regardless of the methodology, cash forecasting has become one of the most important financial tools in managing businesses more effectively. [Sidford, C. (1997)]

2. Benchmarks

As discussed in the previous section, private-sector industry has employed forecasting and modeling in all aspects of business for many years. In most organizations, developed forecasting methods and models become proprietary information, due to the extensive investment of time and resources involved in implementation. Firms become reluctant to share the specifics of the methods they employ, which are largely unique to their business functions. The unique nature of a firm or organization's forecasting methods is inherent in the development of the forecasting techniques, as specified earlier in this chapter. As such, a study of "benchmarks", in this case, private-sector and non-DoD forecasting, will not yield a method that could be readily applied in another organization. However, forecast benchmarks *can* provide the inquiring manager some insights about developing forecasts in different environments.

Several firms and non-DoD organizations were researched for possible use as forecasting benchmarks using information that had been provided to trade publications. Attempts were made to collect information directly from firms, but the firms contacted

either denied employing quantitative forecasting methods or were unwilling to part with proprietary information.

a) *Revenue Forecasting with Time-Series Models in Florida Municipalities*

A case study of Florida municipalities' revenues forecasting was published in *The American Review of Public Administration*. [Frank, H. A. (1990)]

Forecasts of revenue from eight Florida cities suggests that simple time-series models such as the moving average and exponential smoothing may be appropriate for revising revenue forecasts within the fiscal year, a practice that has been shown to help budget closer to the ever-tightening budget restraints they face. However, interviews with local officials and examination of their budget and accounting records confirm prior findings that limited forecasting expertise and data availability in local governments may limit the utilization of these methods. Moreover, the norm of revenue underforecasting,...suggests a degree of risk aversion that may preclude experimentation with the models...Ironically, this may place local officials at greater risk of misestimating revenue at a time when their revenue streams are becoming less reliant on the stable property tax, and more reliant on more volatile, economically sensitive sources such as fees and user charges.

As the quote suggests, the study found that, despite the availability of easy-to-use forecast software programs, local governments have been slow to implement automated revenue forecasting. The study went on to test several quantitative forecast techniques for comparison against the judgmental forecasts developed by the city finance staffs. The results showed that, at short-term horizons (one year), time-series forecast methods performed very well compared to the city forecasts. This performance is consistent with earlier research that time-series forecasts are most appropriate for short-range (one year or less) forecasts [Bretschneider, S. & Gorr, W. L. (1987)].

The study found that, on longer-term horizons in systems with complex variable relationships, quantitative methods did not appreciably improve upon the city finance staff's judgmental techniques. Of further note is the tendency of managers to underforecast revenue, presumably to accommodate risk preferences [Wildavsky, A. (1986)]. Wildavsky views the underforecasting phenomenon as a defense mechanism against over spending in a period of rising expenses and fixed revenue limits.

Finally, although the city attempted to use the more sophisticated, software based approach to forecasting revenue, after a short period of time it reverted to judgmental techniques. The lack of technical expertise was a serious stumbling block in implementing the more sophisticated techniques [Bretschneider, S. & Gorr, W. L. (1987)]. Simply put, people are not likely to forecast with a "black box" approach. Forecast utilizers need to know the assumptions on which a forecast is based. Ignorance of these assumptions is likely to lead to abandonment of such models [Mikesell, J. L. (1986)].

b) A Short-Term Disbursement Forecasting Model

This model was developed to assist firms in cash forecasting using a logic-of-payments pattern approach to forecasting cash balances, and was published in *Financial Management* in 1981. [Maier, S. F., Robinson, D. W. & Vander Weide, J. H. (1981)] This model is interesting because it's design assumptions are very similar to a model being used by Naval Supply Systems Command (NAVSUP), a NWCF activity group manager. The major difference is that the NAVSUP model is *deterministic* while

the benchmark model is designed around *distribution* assumptions. “Deterministic” means that the model variables change in a single, defined amount (e.g. plus \$15 million in disbursements)). A distribution indicates that a variable may change in a specified range (e.g. 5-10 percent increase in disbursements), in which some outcomes are more likely than others.

The logic-of-payments approach involves a lag time between mailing dates of disbursements and the actual clearing dates, not to exceed 90 days for this model. The model uses a historical distribution of time between mailing and clearing dates, and predicts when each disbursement item will affect the checking account. The model continually revises the cash forecast as checks are paid, tracks and updates check-processing times, and produces reports to alert managers to significant changes in check processing times. The model is particularly useful for firms that experience uncertainty associated with check clearings. [Maier, S. F., Robinson, D. W. & Vander Weide, J. H. (1981)]

This model focuses almost entirely on one variable: the time it takes for checks to clear. It is designed not only to compute that variable based on inputs, but also to continually update the variable’s predicted behavior, produce forecasts and alert managers to changes in the variable.

c) ***Sales Forecasting and Cash Budgeting for Automotive Dealerships***

In the retail automotive sector, poor cash management has resulted in the bankruptcy of many dealerships. Thus, a specific model has been developed for dealerships to improve cash management and budgeting, by focusing on sales forecasting and efficient allocation of resources. This model was published in *The Journal of Business Forecasting* in 1992. [Ahadiat, N. (1992)] Although on a much smaller scale, this model's design is similar to cash management at the ASN (FM&C) level of the NWCF. The model's budget portion begins with a cash opening balance, followed by disbursements and revenues, and, finally, an ending balance of cash. The budget forecast is based on an expected set of conditions within and outside the company.

Dealerships, like most firms, are concerned with anticipating cash needs to ensure profits are not depressed by holding too much or too little cash. The concept behind the development of this model was to make it simple enough to be used by managers and small enough to be run on a personal computer with off-the-shelf software. It is a two step model, first forecasting sales by using regression analysis to model the relationship between a dependent variable (car sales) and independent variables (economic and dealer-specific factors). The model is designed using only the appropriate variables affecting sales, and regression equations are estimated to forecast sales. The process of identifying the variables affecting sales was the most critical and involved operators, managers and finance personnel. This process is the "stripping away" of statistically insignificant variables as described earlier in this chapter.

The second step of model development involved preparing a cash budget – which provides a linkage between sales forecasts and expected revenues, expenditures and finance requirements. The model's relationships are the key to predicting the impact that variable changes will have on future cash flows. Additionally, managers have the ability to present “what-if” questions to determine a decision's future impact on cash balances. For example, a manager can predict the future impact on cash of a 2% increase in financing costs.

This model is only as good as the assumptions and awareness of the managers who use it. The environment is constantly changing, and the model must be updated to reflect those changes, or the output it provides will become unreliable. This study found that successful use of this model was heavily reliant on regular monitoring of forecasts and periodic revision of assumptions based on environmental changes.

[Ahadiat, N. (1992)]

The benchmark examples serve to illustrate the variety of models that can be used to forecast cash flows and balances, and each is dependent on the business type. Managers have many options when choosing a model to use, but the key remains developing a realistic, simple, user-friendly model that the manager feels is reliable as a decision-making tool.

IV. DATA COLLECTION AND MODEL REVIEW

A. UNDERSTANDING THE ACCOUNTING CYCLE

Prior to discussing the specifics of NWCF cash management data, an understanding of the NWCF cash accounting cycles, the source of cash management data, must be developed. As discussed in earlier chapters, cash management data are in the form of aggregate monthly reports of collection and disbursement transactions. In general, these data are easily obtained from databases maintained by cash managers at different levels of the NWCF. The cash management data focused on in this thesis came from the NWCF Budget/Program Office (ASN (FM&C)) and from a representative NWCF activity group, the Supply Management Activity Group.

The primary source of data for NWCF cash managers is the Defense Accounting and Finance Service, Cleveland Center (DFAS-CL), although cash transaction information can flow from DFAS Indianapolis (Army), DFAS Kansas City (Marine Corps), DFAS Denver (Air Force) and DFAS Columbus (Defense Agencies). Figures 4.1 and 4.2 illustrate a basic flow of collection and disbursement transactions. The Figures are representative of centralized DFAS transactions generated from a supply-type activity, although the data flow is universal for any type of NWCF business activity. Industrial and other activities differ only in that they are providing services (as described in Chapter II) instead of material.

Other types of transactions that may occur in similar cycles are *Other DFAS Payments* (other than centralized DFAS payments), *Military Standard Requisitioning and Interfund Procedures* (MILSTRIP) (automatic collection of payment by the seller in a material transaction) and *Cross Disbursing* (expenditures made by another service or department against Navy payables). These other transactions will not be discussed in detail.

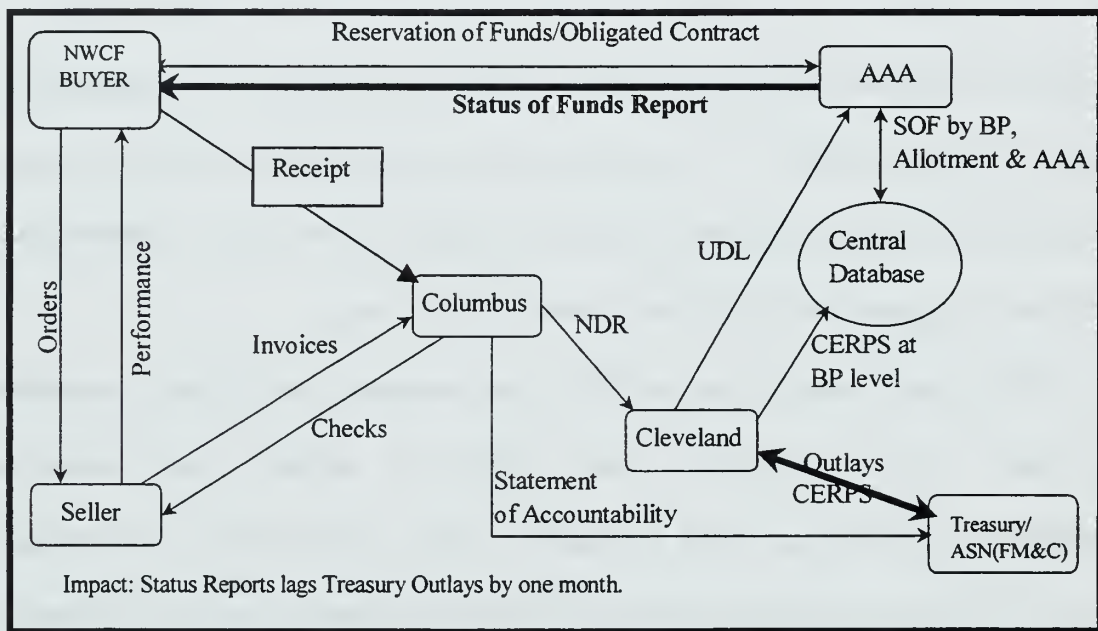


Figure 4.1 Flow of Disbursements

Acronyms	
AAA:	Authorized Accounting Activity
BP:	Budget Project
CERPS:	Centralized Expenditures Reimbursable Processing System
NDR:	Navy Disbursing Records
SOF:	Status of Funds Report
UDL:	Universal Download

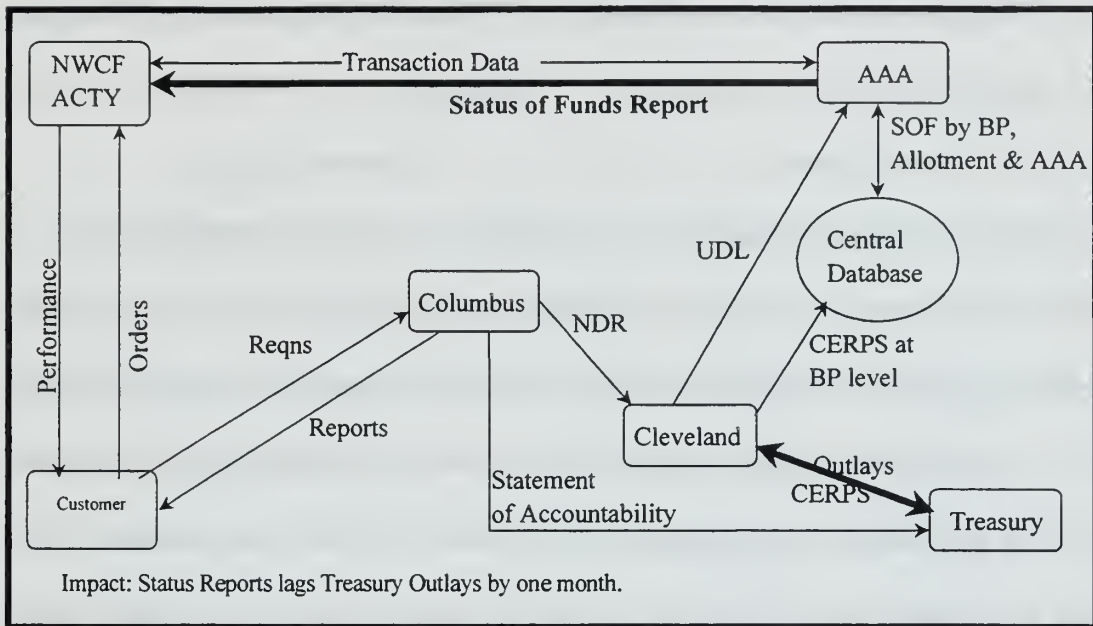


Figure 4.2 Flow of Collections

The disbursement and collection cycles illustrated in Figures 4.1 and 4.2 are nearly identical, except that one describes money leaving the fund in the form of payments (disbursements), while the other describes money coming into the fund in the form of payments from customers (collections). In the collections cycle, the transaction occurs between a *customer* (e.g. ship) and a *NWCF activity* (e.g. Supply Center). In this case, the NWCF provides material and a collection is made from an appropriated fund into the NWCF. Disbursements remove funds from the NWCF, in paying for either operating costs or material.

The critical areas of the figures are not the transactions shown on the left, but the output of data and reports on the right. The following section defines the terms and explains the relationships and responsibilities of the activities involved in the disbursement and collection cycles. The goal of this discussion is to clarify the sources

of cash management data, and to illustrate the complex accounting and reporting that must be completed for each transaction.

1. NWCF Buyer

The NWCF buyer recognizes a requirement to purchase material for sale to customers. The buyer takes action to establish a contract (order) with a seller (vendor). The contracting action includes the interface with the Authorized Accounting Activity (AAA) to initially reserve funds (commitment) and then to obligate funds for a negotiated contract. A valid contract is the basis for buyer orders from the seller. After the seller delivers the material, the buyer transmits receiving reports to the paying office, DFAS-Columbus.

2. Seller

The seller accepts funded orders and performs in accordance with the terms of the contract. Performance will typically be the shipment of supplies to a designated location. Based upon performance, the seller invoices DFAS-Columbus, the paying office for central disbursements.

3. DFAS-Columbus

The buyer provides a certified receiving report to DFAS-Columbus for matching to the invoice before payment can be made. Based on certified invoices, the DFAS-Columbus office issues payment to the seller. Following payment, DFAS-Columbus submits Navy Disbursing Records (NDR) to DFAS-Cleveland for entry into the Centralized Expenditure Reimbursable Processing System (CERPS). DFAS-Columbus

also sends the Statement of Accountability (SF 1219), which indicates the NWCF current cash balance, to the Treasury each month.

4. DFAS-Cleveland

DFAS-Cleveland processes NDR on a daily basis to assign collections and disbursements to Navy accounts by accounting classifications. Using CERPS, DFAS-Cleveland reports collections and disbursements to the Treasury and to the NWCF cash manager at ASN (FM&C), in the form of a facsimile *Activity Control Ledger*.

Each month, transactions are sorted by Appropriation and Authorized Accounting Activity (AAA) to send the Universal Download (UDL) to the appropriate AAA. DFAS-Cleveland also loads summary accounting data, by Budget Project (BP) (used by the Supply Management Activity Group to track cash balances), from CERPS to the Centralized Database (CDB).

5. Authorized Accounting Activity (AAA)

The AAA provides accounting support to the buyer. In this role, the AAA records outstanding obligations based on contracting actions and issued orders. Based on the UDL, the AAA (using the Status of Funds (SOF) accounting system (GO3)) relates reported expenditures to previously recorded obligations and liquidates the obligations. The AAA reports SOF to the NWCF buyer and also posts to the CDB. [Naval Supply Systems Command (1998)]

6. Impact of the Cycles

The impact of the above processing cycles is that CERPS reports Treasury outlays up to one month before the same information is present in the SOF accounting system,

which is used by the NWCF activities. Additionally, CERPS data are forwarded to the NWCF cash manager at ASN (FM&C) up to 45 days after transactions have occurred. The time lag in data delivery can create problems when cash managers are attempting to reconcile differences between SOF accounts and CERPS data. Further, “surprises” are fairly common when the aged data finally reaches the cash managers, and unexpected variances from budgeted plans are discovered. The variances are all the more difficult to resolve given the length of time that has passed since the original transactions occurred.

B. DATA COLLECTION METHODOLOGY

Data were collected at the ASN (FM&C) and NAVSUP (Supply Management Activity Group) cash management offices. The data that follow are displayed in the formats used in the respective branches, but the key data elements remain collections, disbursements, outlays and cash balances, as discussed in Chapter II.

7. ASN (FM&C)

DFAS Cleveland transmits (by facsimile) a monthly CERPS report to ASN (FM&C), called the Activity Control Ledger. This report provides the NWCF cash manager hard copy figures that total the previous month’s disbursements and collections by activity group and other miscellaneous categories for pending transactions. Figure 4.3 provides an example of the Activity Control Ledger which displays cash balances provided by DFAS Cleveland.

**NWCF WORKING CAPITAL FUND
TREASURY CASH REPORT
FOR THE PERIOD ENDING 31 MAY 1998
97X4930.002**

Beginning Balance		977,273,165.25		
CASH BALANCE AS OF		30-Apr-98	31-May-98	Change to Cash
NA1? NSY		432,082,832.58	354,171,007.48	(77,911,825.10)
NA2? NADEPS		145,491,591.89	81,867,110.05	(63,624,481.84)
NA4? MC DEPOTS		(101,954,586.51)	(101,644,987.88)	309,598.63
NA3? NWS		69,624,981.93	88,573,400.40	18,948,418.47
NH2? NAWC		(38,355,745.62)	(59,486,504.46)	(21,130,758.84)
NH1? NSWC		134,606,137.99	59,930,310.07	(74,675,827.92)
NH6? NUWC		121,945,463.03	93,574,651.18	(28,370,811.85)
NH3? SPAWAR		(34,658,643.27)	(52,955,710.50)	(18,297,067.23)
NH4A NRL		27,926,776.69	14,950,333.15	(12,976,443.54)
ND2A MSC		448,057,358.39	440,033,397.65	(8,023,960.74)
NF1? INFO SERVICES		3,165,590.52	(2,106,535.14)	(5,272,125.66)
NE1? PWC		(6,591,422.64)	2,223,286.81	8,814,709.45
NH5A NFESC		(21,121,819.16)	(18,902,032.36)	2,219,786.80
NB?? STOCK DEPOT		(8,911,118.72)	(27,646,623.75)	(18,735,505.03)
NS1? LOGISTICS		(570,085,901.41)	(573,480,644.26)	(3,394,742.85)
NC1? NAVY SUPPLY		555,208,250.06	514,525,304.76	(40,682,945.30)
NC2? MC SUPPLY		48,159,115.47	45,948,359.16	(2,210,756.31)
NG0A NPUB & PRINT		79,093,979.36	78,863,699.13	(230,280.23)
NE3A NAVAL ACADEMY		(127,803.12)	(125,026.13)	2,776.99
NAVCOMPT		180,012,826.03	191,083,020.84	11,070,194.81
NO SUBHEAD OR ERROR		(87,829,437.98)	(86,436,072.96)	1,393,365.02
FY 93 SUPPLY ADJUSTMENT		(527,488,720.78)	(527,488,720.78)	0.00
REGISTER 22 ADJUST		0.00	0.00	0.00
ASN FMO TRANSFER		(30,875,615.89)	(40,709,615.89)	(9,834,000.00)
SPAWARS JV		250,000,000.00	250,000,000.00	0.00
DFAS-CL DEFENSE PRINGTING JV		(34,181,429.12)	(34,181,429.12)	0.00
UNSETTLED	ARMY	(36,874,310.10)	(36,874,310.10)	0.00
	AIR FORCE	(4,667.74)	(4,667.74)	0.00
	GSA	(2,052,747.05)	(2,059,549.40)	(6,802.35)
	STATE NAVY	(23,141,629.99)	(23,321,527.86)	(179,897.87)
	STATE OSD	5,776,050.38	5,776,050.38	0.00
	TREASURY	1,314,456.78	1,045,945.19	(268,511.59)
	JUSTICE	(688,972.59)	(688,972.59)	0.00
	NCTC	(247,674.16)	(247,674.16)	0.00
TOTAL		977,273,165.25	634,205,271.17	(343,067,894.08)

Figure 4.3 Activity Control Ledger from DFAS

The cash manager manually keypunches the data into a database that computes net outlays and cash balances and allows for comparison against budgeted figures. The Activity Control Ledger is identical to the report that is forwarded to the Treasury, and as such the WCF cash balances held at the service level are in agreement with the balance available at the Treasury. Figure 4.4 provides a sample of the database that is used to track the NWCF cash balance. Notably, there are separate sections for forecasted and actual data. This database was the main source of ASN (FM&C) data used in this thesis.

Unfortunately, there are less than two years of historical data archived at ASN (FM&C), due to the 1996 inception of the cash management function at the service (vice OSD) level.

SUMMARY

PRES BUD CASH FORECAST:		OCT	NOV	DEC	JAN	FEB	MAR
CASH OUTFLOW:	Monthly	2,240,169	2,125,384	1,494,103	1,798,444	1,559,724	1,691,242
	Cumulative	2,240,169	4,365,553	5,859,656	7,658,100	9,217,824	10,909,066
CASH INFLOW:	Monthly	1,276,897	1,733,624	1,410,705	2,091,157	1,529,062	1,653,119
	Cumulative	1,276,897	3,010,521	4,421,226	6,512,383	8,041,445	9,694,564
NET OUTLAYS: (Outflow less Inflow)	Monthly	963,272	391,760	83,398	(292,713)	30,662	38,123
	Cumulative	963,272	1,355,032	1,438,430	1,145,717	1,176,379	1,214,502
ACTUALS:							
CASH OUTFLOW:	Monthly	2,035,727	1,879,195	1,302,482	1,702,891	1,310,254	1,615,245
	Cumulative	2,035,727	3,914,922	5,217,404	6,920,295	8,230,549	9,845,794
CASH INFLOW:	Monthly	1,134,129	1,590,459	1,230,820	1,730,293	1,722,525	1,402,683
	Cumulative	1,134,129	2,724,588	3,955,408	5,685,701	7,408,226	8,810,909
NET OUTLAYS: (Outflow less Inflow)	Monthly	901,598	288,736	71,662	(27,402)	(412,271)	212,562
	Cumulative	901,598	1,190,334	1,261,996	1,234,594	822,323	1,034,885
DELTA:							
CASH OUTFLOW:	Monthly	(204,442)	(246,189)	(191,621)	(95,553)	(249,470)	(75,997)
	Cumulative	(204,442)	(450,631)	(642,252)	(737,805)	(987,275)	(1,063,272)
CASH INFLOW:	Monthly	(142,768)	(143,165)	(179,885)	(360,864)	193,463	(250,436)
	Cumulative	(142,768)	(285,933)	(465,818)	(826,682)	(633,219)	(883,655)
NET OUTLAYS: (Outflow less Inflow)	Monthly	(61,674)	(103,024)	(11,736)	265,311	(442,933)	174,439
	Cumulative	(61,674)	(164,698)	(176,434)	88,877	(354,056)	(179,617)

Figure 4.4 NWCF Cash Management Database

2. Supply Management Activity Group

Data collected in this section are representative of NWCF cash management data at the activity group level. The data were provided by the Supply Management Activity Group (NWCF-SM) cash manager. Unlike ASN (FM&C), which assumed responsibility for managing NWCF cash just two years ago, the NWCF-SM has managed cash continuously through the DBOF's existence [Interview, Cash Manager, Naval Supply Systems Command (1998)]. Over ten years of collections, disbursement and outlay data

were available, although changes in the composition of the activities within the group made some of the older data less useful. The data used for analysis were from the last three fiscal years, although as much as ten years' data were analyzed for possible use before being discarded due to inconsistencies driven by changes in accounting systems and the composition of the activity group.

The activity group data require a greater degree of detail than the ASN (FM&C) data. Specifically, activity group managers need to have aggregate collections and disbursements data separated into business activity categories. As illustrated in Figures 4.1 and 4.2 (Centralized Database (CDB) reporting to the AAA), DFAS Cleveland sends the CERPS data by *Budget Project* (explained in the following section) to the CDB, which is the source of data for detailed reports for the activity group manager. The CERPS data are provided monthly in the Universal Download (UDL) to the NWCF CDB (accessed by the NWCF-SM), the Treasury and the AAA. [Naval Supply Systems Command (1997)]

a) *Data Format and Budget Projects*

The activity group cash data are broken down by business categories for cash managers. Specific to the NWCF-SM are business categories known as budget projects (BPs), which are used to identify and account for different categories of material. Budget projects may be further broken down into subcategories of contract type. Figure 4.5 provides a brief description of the BPs.

NWCF-SM Budget Projects (BP)	
BP14	Shipboard Consumable
BP15	Pubs and Forms
BP21	Ship's Store Material
BP23	Shipyards Long Lead Time
BP25	Wash Thru Account
BP28	Retail 9 COG
BP34	Aviation Consumable
BP38	Fuel
BP81	Shipboard Repairable
BP85	Aviation Repairable

Figure 4.5 Supply Management Budget Projects

Collection and disbursement data by BP are extracted from the NWCF CDB by the Supply Management activity group manager to monitor budget execution. The data used for the analysis that follows in Chapter V will frequently appear segregated by BP. The NWCF cash manager uses the BP data in a model used to forecast expenditures; this model will be discussed in detail in a later section. A summary of the NWCF-SM cash management data is provided as Appendix C. Figure 4.6 provides an abbreviated segment of that Appendix.

NAVY WORKING CAPITAL FUND									
DATA ANALYSIS									
SUPPLY ACTIVITY GROUP AGGREGATE									
PERIOD	DATE	PLAN EXP	ACT EXP	NTN EXP	PLAN COL	ACT COLL	MONTH COL	PLAN OUT	ACT OUT
1	Oct-89	689	689	689	338	338	338	350	350
2	Nov-89	1232	1232	543	1366	1366	1028	-134	-134
3	Dec-89	1781	1781	549	1915	1915	549	-134	-134
4	Jan-90	2351	2415	634	2484	2429	514	-134	-13
5	Feb-90	2972	3024	609	3125	3018	589	-153	6
6	Mar-90	3628	3633	609	3860	3653	635	232	21
7	Apr-90	4316	4226	593	4488	4333	680	172	107
8	May-90	4983	4933	707	5100	5119	786	-118	-186
9	Jun-90	5647	5530	597	5732	5527	408	-86	4
10	Jul-90	6279	6105	575	6334	6312	785	-55	-208
11	Aug-90	6909	6744	639	6969	7065	753	-60	-322
12	Sep-90	7598	7426	682	7707	7659	594	-109	-234

Figure 4.6 Aggregate Data for Supply Management Activity Group

C. NWCF CASH MODELS AND FORECASTING

Section 363 of the National Defense Authorization Act for 1997 directed the Secretary of Defense to provide an improvement plan for management of the Defense WCFs not later than September 30, 1997. Nine issues were cited in the section, and subcommittees were formed to develop recommendations for improvement. A major agenda item for the Cash Management subcommittee (chaired by the Army) was to develop an adaptable cash management model for use in the WCFs. Specifically the subcommittee noted:

No automated cash model exists in DoD to assist cash managers in predicting required cash levels, forecasting cash positions, or for predicting end-of-period cash positions on a weekly, monthly or annual basis. All DoD components have been working on aspects of a model and most employ manual methods to track and predict cash. Having a better tool would benefit all components and improve the accuracy and effectiveness of cash managers. Due to differing missions, organizations, workloads and many other factors, no single model will work for all activity groups. However, many expenses and program elements will be common to all models

[Department of Defense Office of the Under Secretary of Defense (Comptroller) (1997)].

The report provided by the Secretary of Defense stated that each service component would continue to develop its own cash management model, and progress was to be reported back to the Defense Working Capital Fund Policy Board. Research indicated that the Department of Defense did not have a cash model in use at the time of the Secretary's report to congress, but was looking to the individual services to develop models and report to the policy board [Interview, Cash Manager, Office of the Under

Secretary of Defense (Comptroller- Revolving Funds), 1998]. Further research indicated that the Navy WCF cash manager did not have a cash management model in use, but was in the process of developing a prototype for data collection and reporting purposes. Of the NWCF activity groups, only one model was in use, at the Supply Management Activity Group at the Naval Supply Systems Command [Interview, Cash Manager, Office of the Assistant Secretary of the Navy (Financial Management & Comptroller), 1998]. The prototype ASN (FM&C) cash management model and the working NWCF-SM model are discussed in detail in the following sections.

1. ASN (FM&C)

The ASN (FM&C) cash manager is primarily focused on timely data collection from activity groups and DFAS, accurate reporting of NWCF cash position to the Secretary of the Navy and reasonably accurate forecasts of future cash positions for inclusion in the President's Budget. Currently, the primary source of budget data, DFAS Cleveland, provides the cash manager with a monthly update by facsimile transmission. Until recently, budget estimate submissions (discussed in Chapter V) from activity group managers also arrived by hard copy report. In an effort to increase efficiency and accuracy in reporting, ASN (FM&C) commenced development of a prototype cash modeling system. Work started in January 1998 by identifying requirements and streamlining current procedures. Current status of the effort is that a near-term solution of developing a cash reporting system has been completed.

a) *Model Description*

The “model” is a simple relational database (*Microsoft Access*) with the initial efforts centered on simplifying data entry, providing automated and graphical reports and maintaining an auditable record of changes. The model has reached the capabilities of receiving budget estimate submissions in electronic format and providing the cash manager with the ability to automatically produce cash reports. The focus of the model design is on budget execution reporting and budget review (submission).

Future improvements planned for this system are automatic monthly updates of execution data from DFAS, development of diagnostic tools to analyze budget estimate submissions and a decision support system to support the budget review process (in forecasting future cash positions). The model relies on the same basic equation for computing cash balances:

Beginning Balance Cash + Collections – Disbursements = Ending Cash Balance

The model is also capable of plan-to-actual comparison, computing advance billing, and producing various output reports, provided as Appendix D. Long-range plans are to complete the prototype and commence development of a Statement of Work to develop a fully functioning cash modeling system.

b) *Model Performance*

As this model is still in the development stage, it is difficult to assess its performance. ASN (FM&C) has completed its first automated budget estimate submission, with few problems, and manual workload has been drastically reduced. The

approach in developing this model is sound; the designer and user recognized early on that a model would have to be developed from the ground up based on ASN (FM&C)'s unique requirements. A significant amount of time was spent simplifying the process to identify only the most important data elements to be included in the model. A step-by-step approach to building modules has further simplified the cash management system.

The model has already achieved success in automating some data collection and report generation. The key to this model's future success, however, will reside in its ability to forecast cash positions based on the input it receives. As discussed earlier, the cash management actual and forecasted data at the ASN (FM&C) level are *aggregate*; that is, a collection from 17 activity groups and over 50 activities. As such, the factors affecting the variables (collections and disbursements) are too numerous to include in any model. [Liao, S. S. (1998)] The ASN (FM&C) model, therefore, may not easily lend itself to the traditional quantitative forecasting techniques mentioned in Chapter III. A possibility for improving this model's capability to predict future cash positions may lie in a *probabilistic approach* of modeling, as described in the later sections of Chapter III. Further discussion of this model is provided in Chapter V.

2. Supply Management Activity Group (NWCF-SM)

The Supply Management Activity Group manager, NAVSUP, originally adapted their cash management model in the 1980s from a model that was in use at the Office of the Comptroller of the Navy (NAVCOMPT) (now ASN (FM&C)). The model was designed to project cash positions, specifically by computing a forecast for expenditure

balances. This original model remained in use, with little modification, until early in 1998. Problems in forecast accuracy (see Figure 4.7) prompted a review of the model and NAVSUP found that the model was in need of an overhaul due to changes in business practices, accounting systems and economic conditions. A new model was developed, using the old model as a foundation, incorporating modern software programming and enhanced reporting capabilities. The basic premise for the new model is unchanged. That premise is that expenditures lag obligations by a predictable Financial Lead-time (explained in detail in the following section).

Cash Flows	Plan	Actual	Delta
Collections	5,653.7	5,210.7	-443.0
Expenditures	5,598.2	5,782.2	184.0
Net Cash	55.5	-571.5	-627.0

(\$Millions)

Figure 4.7 NWCF-SM Comparison of Planned to Actual Cash Flows for FY 97

a) Model Description

As stated earlier in this chapter, the NWCF-SM manages within a budget project structure. BPs are classified as being wholesale, retail, support or clearance in nature. The Naval Inventory Control Point (NAVICP), a major operational arm of NAVSUP, manages the wholesale BPs, while NAVSUP manages the retail, support and clearance BPs. NAVICP is located in Mechanicsburg (NAVICP-M) for ships support and in Philadelphia (NAVICP-P) for aviation support. [Naval Supply Systems Command (1998)]. The BP structure is defined in greater detail in Figure 4.8.

BP	Type	Proponent	Description
BP14	Wholesale	NAVICP-M	Shipboard Consumable
BP15	Retail	NAVSUP	Publications and Forms
BP21	Retail	NAVSUP	Ship's Store Material
BP23	Retail	NAVSUP	Shipyards Long Lead-time
BP25	Clearance	NAVSUP	Wash thru Account
BP28	Retail	NAVSUP	Retail 9 COG
BP34	Wholesale	NAVICP-P	Aviation Consumable
BP38	Retail	NAVSUP	Fuel
BP81 (See Note)	Wholesale	NAVICP-M	Shipboard Repairable
BP85 (See Note)	Wholesale	NAVICP-P	Aviation Repairable
BP91	Support	NAVSUP	Supply Management (ICP)
BP92	Support	NAVSUP	Distribution Depots
BP93	Support	NAVSUP	Logistics Support Activities

Note: The repairable shipboard and aviation BPs, Depot Level Repairables, are managed as two components. The first component is Procurement, which buys the repairables. The second component is Rework, which finances the repairs. Accordingly, NAVICP-M manages BP81P (Procurement) and BP81R (Rework) separately. That same pattern is followed by NAVICP-P for BP85.

Figure 4.8 Definition of Budget Projects (BP)

The new model is a *Microsoft Excel* spreadsheet with a custom toolbar built in for the forecasting function. While the model does project *outlays*, it is primarily an *expenditure* forecasting tool. Figure 4.9 is illustrative of a section of the model.

Forecasting Data for Budget Projects within NAVSUP Stock Fund

Budget Project	BP34
BP Title	Aviation Consumables
Sub Type	Null
Contract/Weapon Type	All
Contract/Weapon Definition	Null

Cumulative Obligations

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
FY 1990	61.9	95.1	126.4	151.6	210.6	268.1	315.6	325.7	390.7	434.2	488.2	511.9
FY 1991	67.3	113.4	145.6	248.4	322.8	369.8	425.8	429.6	450.7	518.2	578.7	625.3
FY 1992	32.0	82.8	114.1	144.3	191.8	252.4	276.2	337.9	343.6	381.5	432.6	488.9
FY 1993	40.0	79.7	124.1	152.8	183.1	208.8	241.4	279.6	329.6	381.7	419.7	458.2
FY 1994	29.8	67.4	114.1	127.2	178.2	182.2	227.3	252.9	272.9	302.0	331.2	368.8
FY 1995	19.7	38.8	72.1	102.0	122.5	148.3	173.7	218.2	274.2	309.7	323.2	352.6
FY 1996	42.1	89.6	145.6	205.4	244.4	281.5	317.3	340.5	377.0	382.4	387.6	431.4
FY 1997	52.9	71.6	129.4	190.3	202.6	218.8	246.9	260.1	268.5	271.2	263.9	262.6
FY 1998	44.1	69.7	98.5	124.8	151.5	190.8	219.6	242.3	264.3	286.1	307.5	332.4
FY 1999	26.8	45.6	75.3	105.2	121.9	141.9	161.9	179.4	200.1	211.2	216.7	233.1
FY 2000	22.9	38.9	64.3	89.8	104.0	121.1	138.1	153.0	170.8	180.2	184.9	198.9
FY 2001	20.6	35.0	57.9	80.8	93.6	109.0	124.4	137.8	153.8	162.3	166.5	179.1
FY 1990	1669.4	1655.2	1627.8	1577.8	1582.3	1582.2	1567.1	1505.5	1504.8	1479.2	1473	1416.9
FY 1991	1411.7	1395.3	1348.9	1388	1415.4	1398.2	1369.4	1298	1262.4	1275.4	1271.1	1256.8
FY 1992	1222.2	1223.3	1186.2	1154.2	1142.8	1142.8	1106.9	1109.6	1052.4	1030.1	1024.6	1031.4
FY 1993	1021.1	1028.7	950.2	922.1	891.4	901.2	878.6	849.5	865.5	877	865.2	865.3
FY 1994	855.3	851.7	863.3	828.3	838.9	793.7	804.9	795.9	765	762.9	750.1	752.6
FY 1995	732	716	712.7	717.3	699.9	679.7	699.4	672.1	693.2	705	667.2	657.8
FY 1996	658	663.9	677	696.7	710	713.9	703.9	681.2	682.8	636.2	602.4	600
FY 1997	614.4	594.8	612.4	628.3	606	583.4	568.3	541.5	512	471.4	464.2	409.6
FY 1998	411.1	410.2	403.2	396.4	403.8	413.3	395.9					
FY 1999												
FY 2000												
FY 2001												

Financial Leadtimes

	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep
FY 1990	24.9	25.6	26.1	25.8	26.3	24.9	25.1	24.8	24.6	24.9	25.2	24.7
FY 1991	25.2	25.5	24.7	24.4	24.6	24.8	25.2	25.0	24.6	24.6	24.8	24.9
FY 1992	25.4	26.0	25.9	25.0	24.4	24.4	24.2	23.4	22.1	22.3	22.5	22.7
FY 1993	22.4	22.8	22.5	22.5	22.4	23.1	21.6	21.6	22.0	22.1	21.8	22.2
FY 1994	22.1	22.1	22.8	22.5	23.1	24.6	23.1	22.6	22.5	22.8	23.0	23.4
FY 1995	22.2	22.1	21.9	21.9	21.8	21.7	22.6	22.2	22.3	22.7	22.2	22.1
FY 1996	22.2	21.6	20.8	20.9	20.9	20.4	19.9	19.4	18.8	18.1	17.0	16.8
FY 1997	16.9	17.2	17.2	16.9	20.1	16.5	16.6	16.9	17.3	17.3	18.3	17.9
FY 1998	17.6	17.6	16.0	16.2	16.8	17.2	16.7					
FY 1999												
FY 2000												

Figure 4.9 Supply Management Activity Group Expenditure Model

Forecasted collection figures, based on wholesale and retail net sales plans (generated by the Navy Inventory Control Point (NAVICP)) and anticipated receipt of reimbursables, are entered into the spreadsheet. Historically, the NAVICP sales forecast has been reasonably accurate, as illustrated in Figure 4.10. (Development of the NWCF-SM collections forecast will not be discussed in detail.)

(\$M)	FY92	FY93	FY94	FY95	FY96
Wholesale					
Pres Bud Plan	3,945.3	3,513.9	3,218.5	4,162.6	3,117.0
Actual	4,010.4	3,677.0	3,778.4	4,071.6	3,149.1
Delta	65.1	163.1	559.9	-91.0	32.1
% Delta	1.7%	4.6%	17.4%	-2.2%	1.0%
Retail					
Pres Bud Plan	3,118.5	2,765.5	2,451.3	2,352.9	2,113.1
Actual	2,988.9	2,827.5	2,580.4	2,272.1	2,151.1
Delta	-129.6	62.0	129.1	-80.8	38.0
% Delta	-4.2%	2.2%	5.3%	-3.4%	1.8%

Figure 4.10 Forecasted Collections – Supply Management Activity Group

Expenditures are projected based upon the monthly phasing of obligations and average Financial Lead-times (FLT – described in detail in this section). Data are collected and reported by Budget Project. The model forecasts future expenditures from monthly unliquidated obligations (ULOs) and current monthly net obligation data. The model stores source data and calculates a FLT and expenditure projection for each BP (and some sub-BPs, based on contract type) separately. The model works on two basic assumptions:

- ULOs at the beginning of the period (BOP) plus New Net Obligations during the period, minus New Expenditures during the period, equal ULOs at the end of the period (EOP) (This relationship must be true for the model to work);
- The average Financial Lead-time (FLT) for each BP, which is a specific point in time (PIT), is a function of the ULOs and the timing of obligations. The model calculates FLTs as the average time from the obligation of funds until they are expended.

FLTs are calculated and expenditures forecasted specifically for each BP. The model only projects annual expenditure rates. It does not forecast monthly expenditure values.

Financial Lead-times (FLT)

The model computes FLTs monthly; but only a single FLT, estimated by the cash manager based on monthly FLTs, is used for projecting expenditures. Use of FLTs in this manner provides a monthly track against the desired September benchmark, but it assumes the end of FY cash balance is the financial objective. The model does not identify or project seasonal or other FLT changes. Expenditures are assumed to occur at a point-in-time (PIT) which is represented by the computed average FLT.

Expenditure forecasts depend on ULOs. ULOs are obligations, actual and/or projected, for which payment has not been made. For longer FLTs, actual obligations can be used to make the forecast. BPs with shorter FLTs must depend more heavily on projected obligations to forecast expenditures.

As empirical data are added to the model over the course of time, forecasted FLTs are replaced by *actual* FLTs computed for September of each fiscal year, to provide a baseline for the computation of the next year's expenditure projection. When completing a fiscal year, prior year forecasted disbursements and unliquidated obligations must be revised using the *computed* end-of-period FLT, as illustrated by the excerpted section of the model in Figure 4.11.

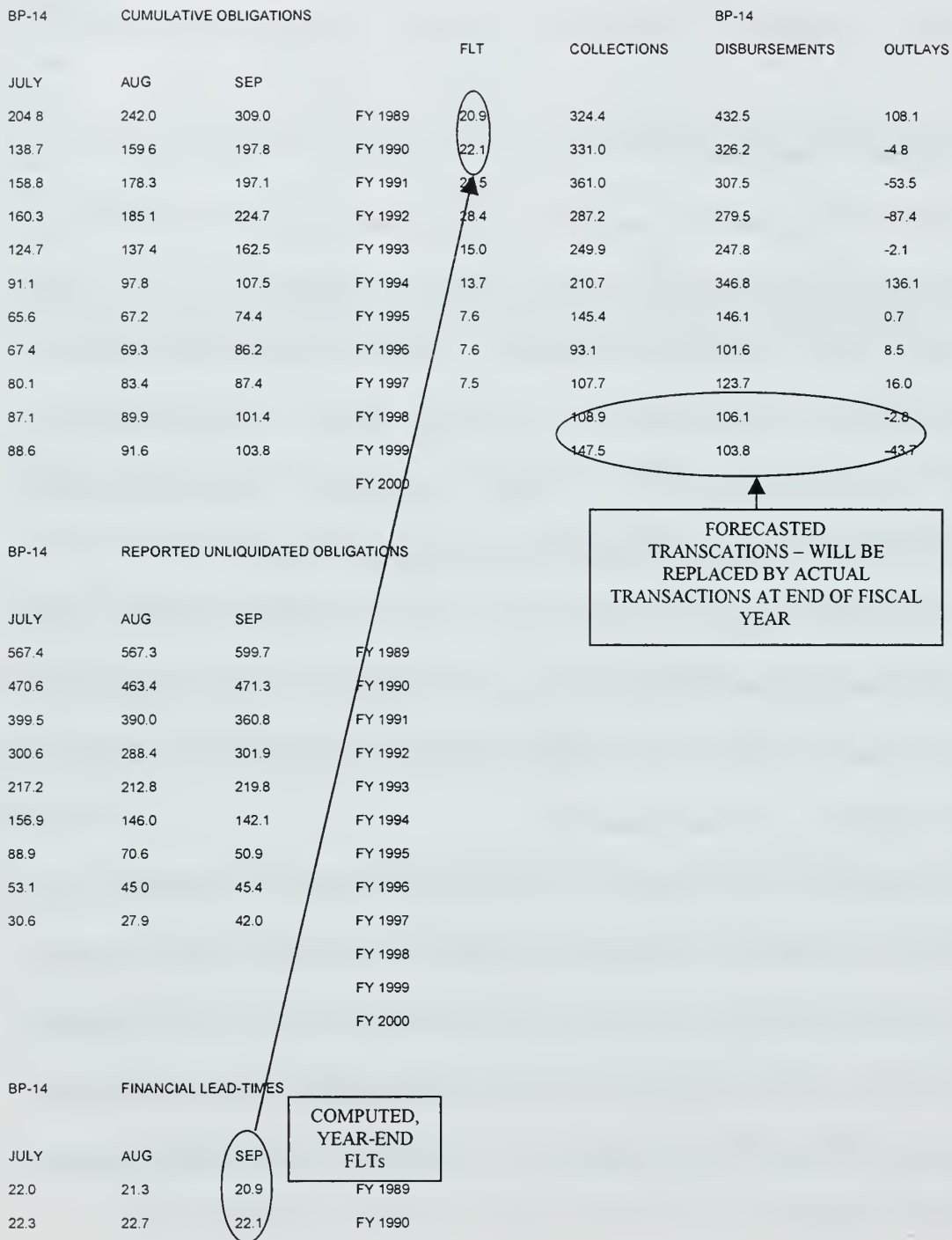


Figure 4.11 Expenditure Forecast Model – FLT

The importance of correctly specifying FLT is emphasized by the illustration of the FLT two-step calculation, depicted in Figure 4.12. Figure 4.12 defines the ending point for FY 1997 and the starting point of obligations that should be used to forecast FY 1998 and 1999 expenditures.

Point A in Figure 4.12 defines when the sum of Monthly Obligations = value of ULOs for 30 September 1997, and is the starting point for the next year's (FY 1998) expenditure forecast. Since FLT is based upon single point in time expenditures, the model assumes that for FY 1997 all obligations prior to Point A have been expended and all obligations after that point are unexpended.

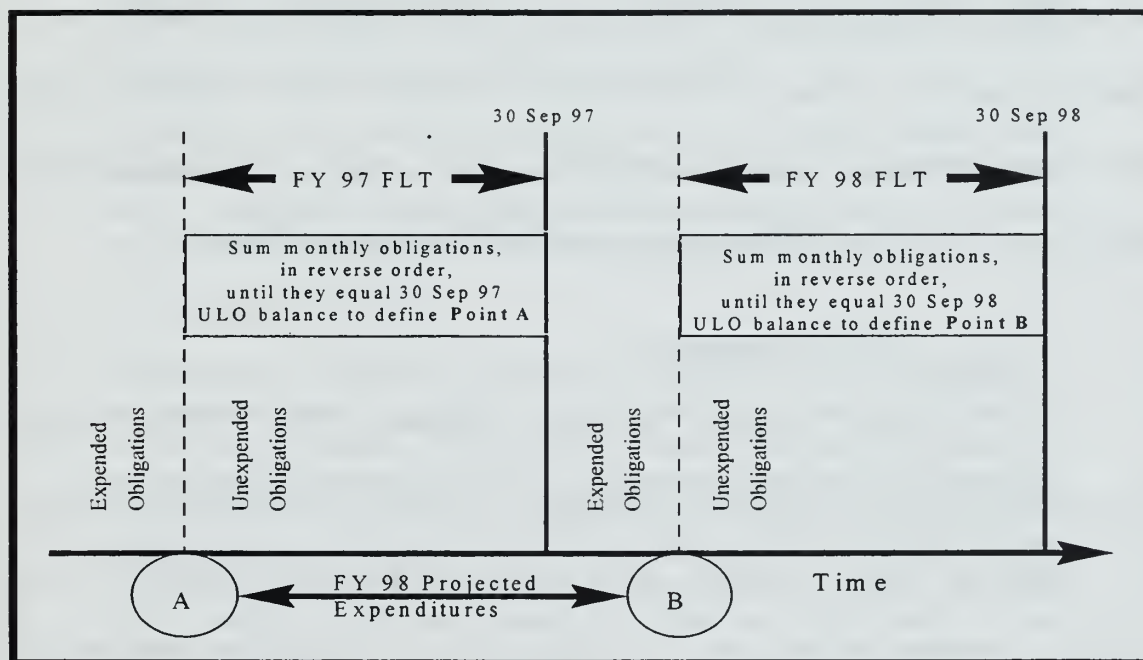


Figure 4.12 Illustration of Financial Lead-time Boundaries

Points A and B define the boundaries of obligations that are used to forecast expenditures for FY 1998. Point B in Figure 4.12 is the point at which the sum of

Monthly Obligations = value of ULOs for 30 September 1998. All obligations prior to point B have been expended by 30 September 1998, and all obligations after point B have not been expended. Thus, the model projects that all obligations between points A and B will be expended during FY 98.

In summary, the NWCF-SM model uses the previous year's actual FLT to determine at what point in time obligations have been expended, particularly, what obligations have been expended by the end of the fiscal year. The expenditure forecast is then phased by month, using historical monthly expenditures. Finally, the phased expenditures are subtracted from the phased collections (mentioned in the earlier part of this section) to calculate outlays. From this point, cash managers can determine cash balances forecasted by adding or subtracting the outlay figure from the beginning cash balance brought forward. All of this process is used to report cash budget estimate submissions to ASN (FM&C) for inclusion in the DoN budget submissions.

b) Model Performance

As alluded to earlier, the recent inaccuracy of the NWCF-SM cash forecasts prompted an overhaul of the cash model. As Figure 4.7 illustrates, the accuracy of the forecasted outlay was poor, and research indicated that the problem was inaccurately forecasted expenditures. An extensive study of the model was conducted in 1997, and a summary of the findings of that study is provided as follows:

Summary and Recommendations

Budget Project Orientation of Management

Observation: The NAVSUP Model reflects the BP orientation of financial information maintained, analyzed, and reported by NAVSUP. Economic and political dynamics have resulted in reduced FLT's for a variety of reasons:

Contracting offices are using more responsive contract vehicles;

Contractors are becoming more responsive; and

Financial organizations are more focused on expenditure management and more efficient in clearance procedures.

Requirement: The recommended Model must be able to portray dimensions within BPs.

Basis of Forecasting

Observation: The NAVSUP Model features a solid methodology for FLT computation. However, there are inconsistencies in the empirical data that is being used to perform expenditure forecasts. Specifically, historically reported obligations and ULO balances are no longer correct because the accounting systems do not track de-obligations and re-obligations on a month by month basis. In a downsizing environment, it becomes more important that FLT's and the resultant forecasts of expenditures are more precise.

Requirement: The recommended Model needs to use officially reported data, supplemented by reports of de-obligations in order to derive a restated obligation profile. This profile, together with reported expenditures, allows for correct tracking of ULO's and improved precision in computing FLT's.

Scope and Software Platform

Observation: The current NAVSUP model is hosted on Lotus 123 software. It uses extensive macros to perform all of the calculations that are necessary to forecast cash expenditures. The model generates correct results, provided it is used precisely as intended. The model is inflexible in that it was developed for a set number of already named BPs unless extensive modifications are made by an experienced Lotus 123 programmer. One manifestation of this situation was that BP91, BP92, and BP93 were grouped into one set of tables in the model. The model is subject to abnormal terminations during use. Furthermore, no user documentation exists.

Requirement: The recommended Model should be: Implemented using compatible software which is capable of interacting with a relational database;

Flexible enough to accommodate all of the BPs and multiple levels of granularity within the same database structure; and

User-friendly with a graphic user interface and on-line, context-sensitive help.

Accounting Procedure Considerations

Observation: NAVSUP uses Select Indicator data from the CDB to populate the current model except for ULOs. Current accounting practices at the NAVICP locations have not tracked de-obligations to the prior accounting month in which they occurred.

Requirement: The NAVICP locations should track and report de-obligation data to NAVSUP in order to calculate FLT's with more precision. The implication for the new Model is that it must be able to accept these reports each month and generate the restated obligation profile.

Obligation Projections

Observation: When projecting obligations, the Model applies an average percentage from the last four years of actual obligations. Empirical data indicates this is not consistently reliable.

Requirement: The recommended model should allow use of more than one approach to projecting obligations in a fiscal year.

Expenditure Projections

Observation: The Model forecasts an annual expenditure amount but does not forecast monthly expenditure amounts.

Requirement: The recommended model must forecast expenditures by month.

[Naval Supply Systems Command (1998), Project Report: Navy Stock Fund Cash Management.]

As a result of the study, NAVSUP completed an extensive revision of the model, which has been in use since early in 1998. The performance of the new model has yet to be tested, as plan versus actual comparisons are not yet possible, given the short time period elapsed.

V. ANALYSIS

The focus of this chapter will be on the analysis of data that were collected at ASN (FM&C) and at NWCF-SM (Supply Management Activity Group manager). The data sources, collection methodologies and presentations were described in Chapter IV. The data analysis specifically includes assessment of data quality, trend analysis and evaluation of suitability for forecasting applications.

A. QUALITY OF DATA

Data quality refers to the reliability, stability and quantity of data available. Reliability can be affected by poor data collection and storage, inaccurate data sources and environmental changes that may “skew” data. Environmental changes can include changes in the population or system that the data are collected from, or accounting and policy changes that may affect the consistency of the data source. To be considered of useable quality, the ASN (FM&C) and NWCF-SM data should be reliable in that the data “match” at different levels of the NWCF and the Treasury. The data are considered reasonably stable if the contributing activities have not radically changed in composition or business practices in the defined period. Sufficient quantities refer to the fact that certain model applications require a minimum number of observations to be considered useful; for example, time series models require at least 25 observations to be deemed valid [Wheelwright, S. and Makridakis, R. (1985)]. Obtaining sufficient quantities of data may be difficult, considering the recent establishment of the NWCF.

1. ASN (FM&C)

As discussed in Chapter III, the data collected from ASN (FM&C) are limited in quantity due to the recent (1996) creation of the NWCF. The data that are available include fiscal years 1997 and 1998 to date. Data prior to this period are not available by individual service, but as an aggregate of all the services' WCFs, or the DBOF. DBOF data are further compromised in quality because the Navy section of the DBOF included different activities than those included in the current NWCF.

An additional factor affecting the reliability and stability of the ASN (FM&C) data is the erratic and sometimes erroneous transaction processing by the DFAS organization. Problems have included late processing of prior year transactions, double postings and erroneous postings to the Navy accounts [Interview, Cash Manager, ASN (FM&C) (1998)]. Often these postings have caused large variations in the data that are not attributable to system performance. Despite these problems, the data that are available are of useable quality, with transaction and cash balances matching at ASN (FM&C) and the Treasury.

2. Supply Management Activity Group

The data collected from NAVSUP included over ten years of transactions and cash balances, much of it in hard-copy format. However, there are reliability problems associated with the older data due to the same factors experienced with the ASN (FM&C) data. Specifically, NAVSUP has undergone organizational changes, many effected by the Defense Management Review Decisions mentioned in Chapter I as well as the Navy

Stock Fund-to-DBOF-to-NWCF transitions. For the same reasons listed for the ASN (FM&C) data, it was decided to use only the recent, stable data that reflect the current activity group composition.

The NWCF-SM has also experienced reliability and stability problems with their data due to problematic transaction processing by the DFAS organization. Figure 5.1 illustrates the major anomalies that have occurred since fiscal year 1996.

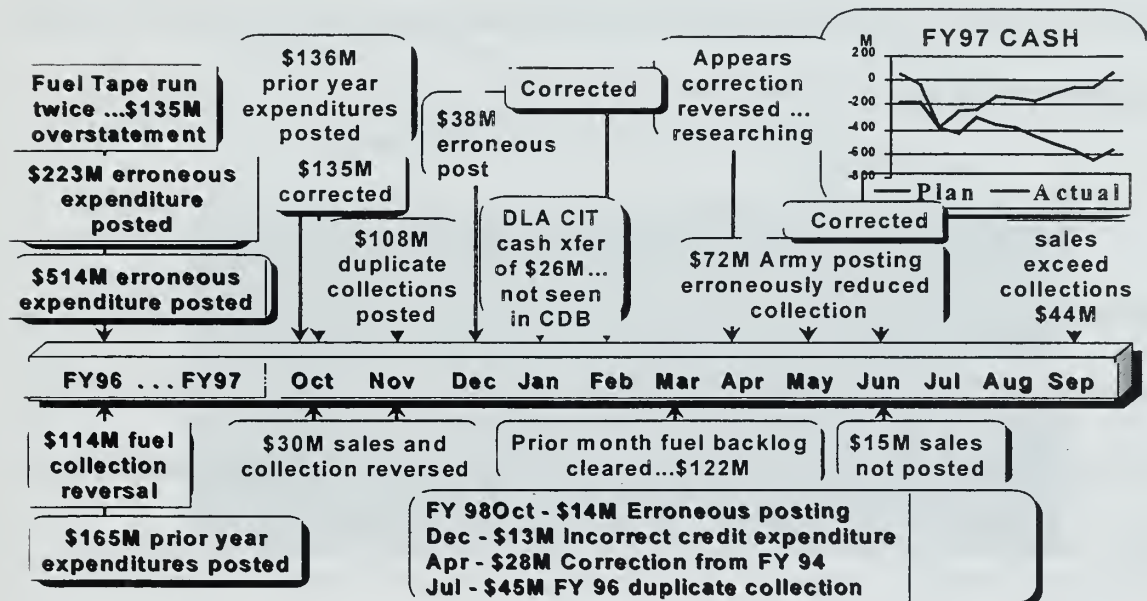


Figure 5.1 Supply Activity Group Accounting Anomalies
[Naval Supply Systems Command (1997)]

As illustrated, the various posting problems have introduced instability in the data. Posting problems are being reduced through DFAS programming initiatives. The three most recent fiscal years reflect these initiatives in the stability that is evident in

transaction patterns. Despite the posting problems, the data in the three most recent fiscal years are considered of useable quality and match the balances retained at ASN (FM&C).

B. TREND ANALYSIS

Trend analysis was completed utilizing a graphical approach. The collected data, in the form of disbursements, collections and outlays, were plotted over time to determine if trends, seasonal or cyclic patterns were discernable. Several other data elements were reviewed for patterns, including outlays, financial lead-times and differences between planned and actual data. When patterns were discernable, an attempt was made to model the patterns using the methods detailed in Chapter III.

1. ASN (FM&C)

The limited availability of good quality data also limits the ability to discern patterns in transactions. Additionally, the fact that these data are a compilation of transactions from over 50 activities tends to “cancel out” discernable patterns. Figures 5.2 and 5.3 graphically illustrate the plot of expenditure and collection transactions over time.

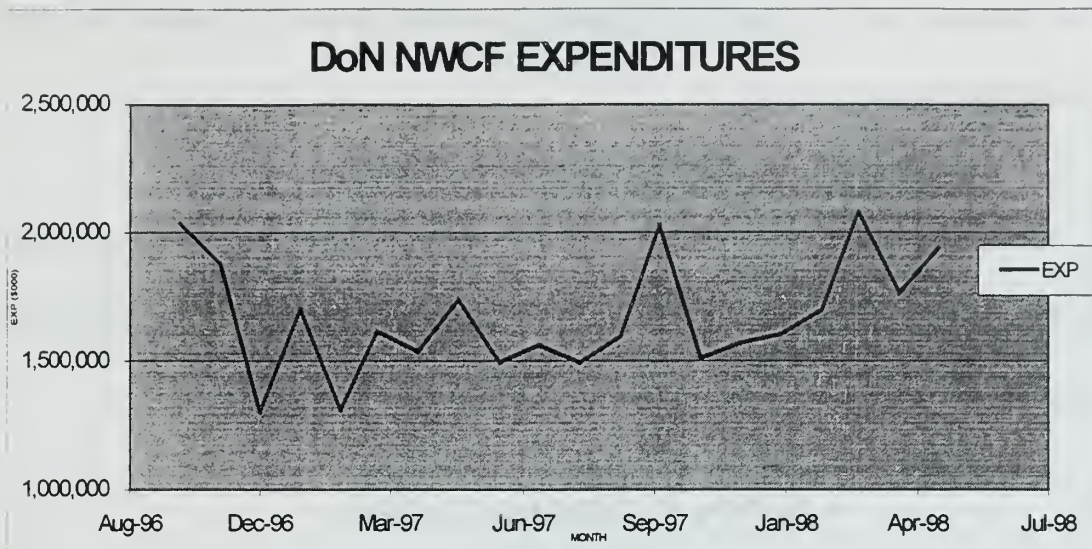


Figure 5.2 DoN NWCF Expenditures Trend Graph

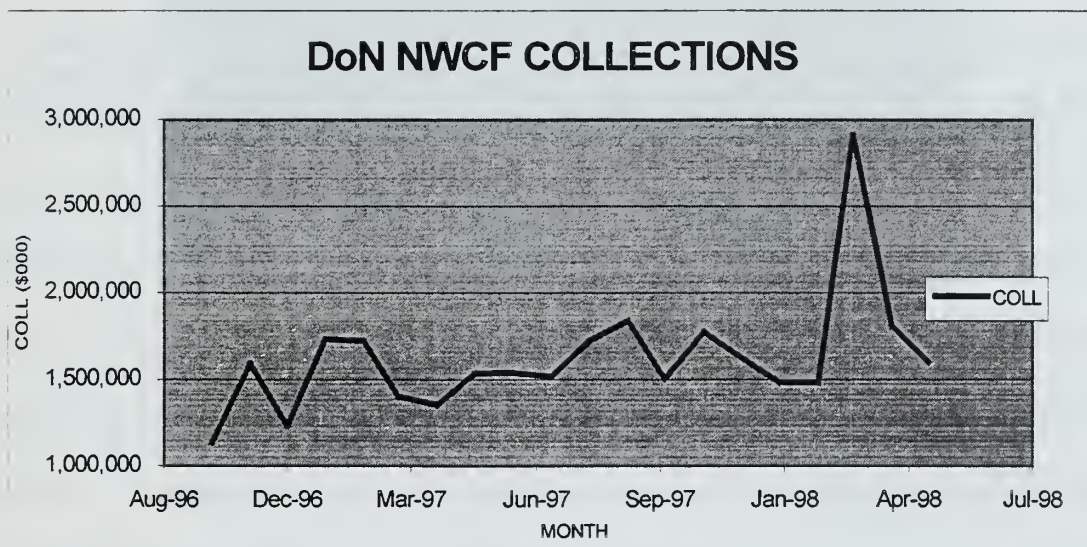


Figure 5.3 DoN NWCF Collections Trend Graph

The difficulty of discovering a pattern is evident when the data are graphically represented. There may be a pattern, but it is not yet evident. Available data cover less than two twelve-month cycles. Patterns in this system could occur seasonally, or on a quarterly cycle, or even around key budget submission timeframes, such as mid-year

review. When more data are available, managers could look for such patterns based on their familiarity with the system.

2. Supply Management Activity Group (NWCF-SM)

Several elements from the activity group data were graphically plotted over time to see if patterns existed. Figures 5.4 and 5.5 provide graphical illustrations of NWCF-SM expenditures and collections, over the most recent three-year period.

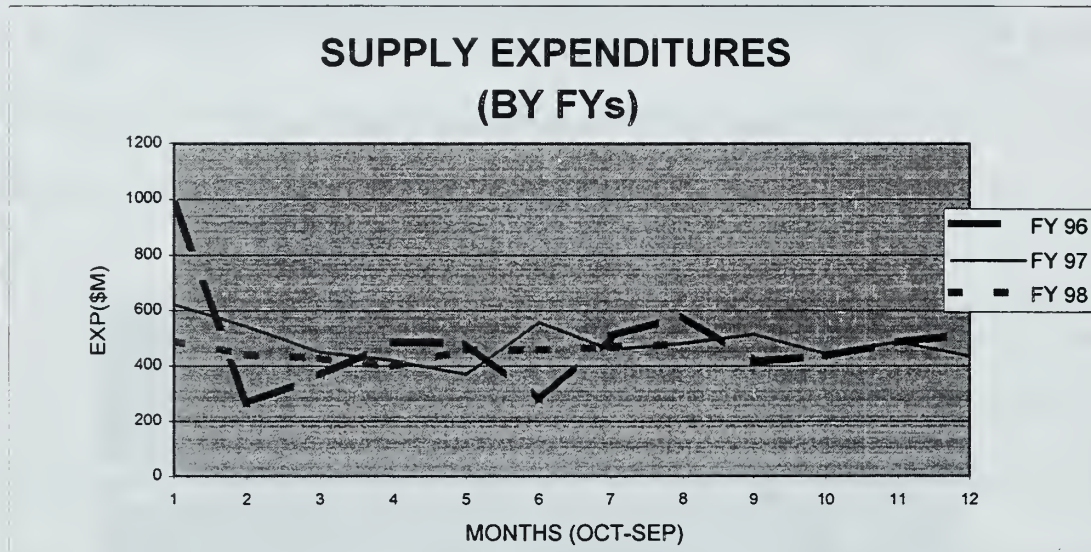


Figure 5.4 Supply Expenditures Trend Analysis

SUPPLY COLLECTIONS (BY FYs)

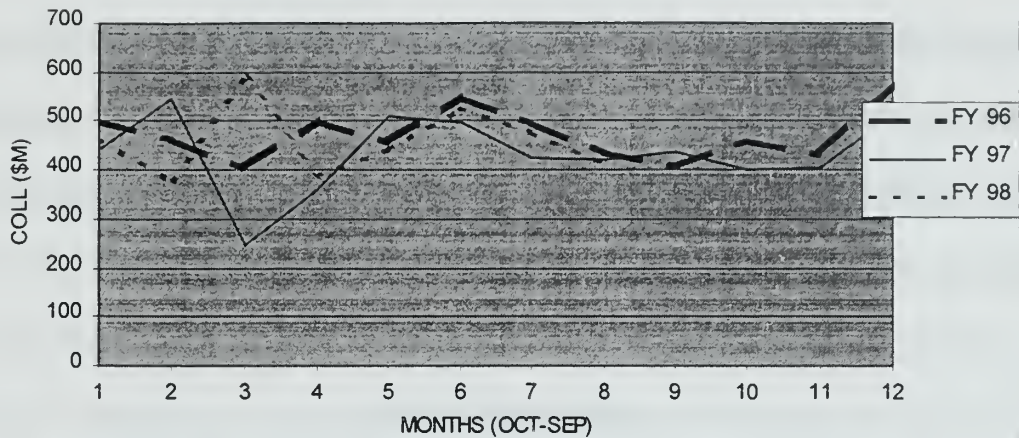


Figure 5.5 Supply Collections Trend Analysis

Even with three years of data available, it is difficult to see a clear pattern in the NWCF-SM transaction data. It appears that the more recent the data are, the more stability there is in month-to-month transaction balances. This stability can possibly be attributed to the aggregate effect mentioned in the above trend analysis of ASN (FM&C) data, or it could be that the system is becoming more stable, and thus easier to predict. Regardless, the NWCF-SM collection and expenditure data reveal no obvious patterns in variations. Further trend analysis included graphically plotting outlays, variations from plan, long-term (i.e. 10 year) transactions, unliquidated obligations and plots by budget project. None revealed any discernable patterns.

Long term trends were discovered, however, when plotting budget project (BP) financial lead-times (FLTs). Fourteen out of thirty BP sub-categories showed long-term trends when plotted against time; graphical depictions are provided as Appendix E. Figure 5.6 provides a sample graphical display of a monthly BP FLT that displays a long term trend.

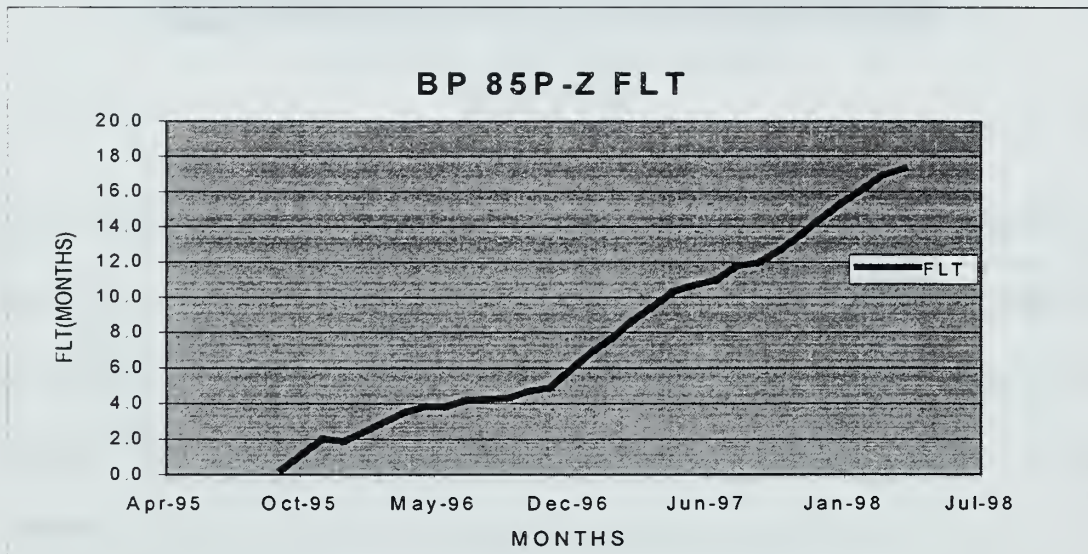


Figure 5.6 Sample Budget Project FLT Trend

FLTs, as described in detail in Chapter IV, are a calculated measure of how long (i.e. in months) it takes for an obligation of funds to be paid out. This measure is a critical element in the NWCF-SM's expenditure forecasting model and will be discussed in detail in the next section. When patterns are evident in data, a forecaster can use those patterns to better determine what conditions will be in the future.

c. FORECASTING APPLICATIONS IN THE NWCF

1. ASN (FM&C)

As discussed in Chapter IV, ASN (FM&C) is in the prototype stage of developing a cash management model. Currently, the model is deterministic, with definite variables and output. The model is used primarily for reporting, but future improvements include decision analysis support and forecasting capabilities. As discussed previously, the data are not currently adequate in duration to reveal any patterns with which to construct a time-series or regression analysis model for forecasting future cash balances. However, the data may be adequate to develop variable distributions that can be used to make the current deterministic model probabilistic. For example, a range of monthly values, with probabilities, could be developed for collections, thus describing a probability distribution for each month of collections. ASN (FM&C) fiscal year 1997 collection transactions were used to develop the distribution that appears in Figure 5.7.

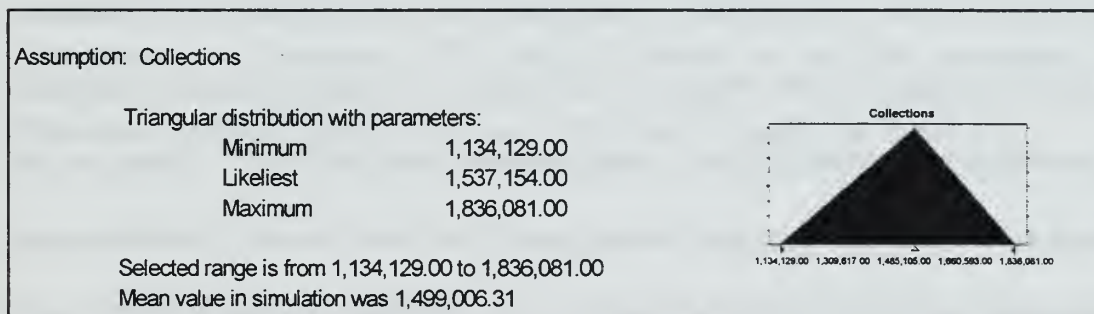


Figure 5.7 Probability Distribution for Collections

The above distribution represents pessimistic, most likely and optimistic values in the distribution of possible values of the variable. These values were determined by using the *Descriptive Statistics* function in *Microsoft Excel*, illustrated in Figure 5.8.

Collections			
<i>Point</i>	<i>Row1</i>	<i>Rank</i>	<i>Percent</i>
12	1,836,081.00	1	100.00%
4	1,730,293.00	2	90.90%
5	1,722,525.00	3	81.80%
11	1,722,418.00	4	72.70%
2	1,590,459.00	5	63.60%
9	1,537,154.00	6	54.50%
8	1,534,607.00	7	45.40%
10	1,516,593.00	8	36.30%
6	1,402,683.00	9	27.20%
7	1,353,392.00	10	18.10%
3	1,230,820.00	11	9.00%
1	1,134,129.00	12	.00%

Figure 5.8 **Statistics on FY 1997 ASN (FM&C) Collections**

The *Excel* output shows how the software ‘ranks’ the data, from the optimistic result (i.e. rank 1, the observation from month 12 - September 1997) to the pessimistic result (i.e. rank 12, the observation from October 1996). The assumptions about variable distributions can also be established and adjusted by the ASN (FM&C) cash manager, based on knowledge of future events or even intuition. For example, the cash manager may know that a particular activity is being removed from the NWCF. Based on this information, the cash manager could adjust assumptions about monthly collections and disbursements to reflect the deletion of that activity. Similarly, the cash manager could make assumptions about anticipated growth or decline in business areas. Figure 5.9 provides an illustration of an external variable (i.e. growth) distribution based on management’s assumptions.

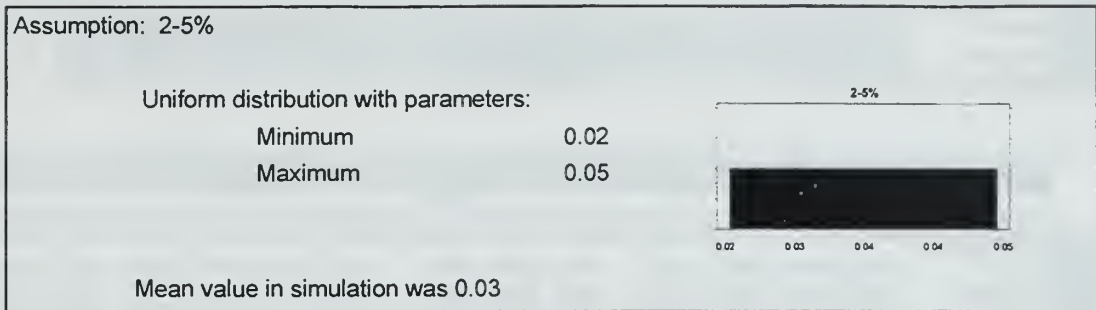


Figure 5.9 **Growth Variable Distribution**

In Figure 5.9 management assumes a *uniform* distribution; that is, there is an equal probability that growth will occur at a percentage anywhere in the range of 2 to 5 percent. Unlike the distribution of collections, which was based on historical performance, the growth distribution is based on management's "best guess" about growth in the coming year. A good simulation model will have a variety of variable distributions based on many different assumptions.

Using actual DoN data, a simple probabilistic model for ASN (FM&C) cash management was developed. The model is based on the basic assumption that **Collections – Disbursements = Outlays**. The model is depicted in Figure 5.10.

Transaction	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL
Beginning Balance	90												
Collections	24129	27125	14156	17125	17225	14225	13336	12317	13715	15215	17218	16218	18,311,154
Disbursements	203527	187919	130248	170289	131025	161524	153839	173874	149546	156242	149428	159539	19,270,498
Outlay	-90158	-28736	-7166	27402	41227	-21552	-18499	-20414	41694	-45835	22134	24067	-95944

Transaction	O	N	D	J	F	M	A	M	J	J	A	S	TOTAL
Beginning Balance	1134129	1590459	1230820	1730293	1722525	1402683	1353392	1534607	1537154	1516593	1722418	1836081	18311154
Collections	2035727	1879195	1302482	1702891	1310254	1615245	1538391	1738747	1495460	1562428	1494284	1595394	19270498
Disbursements	-901598	-288736	-71662	27402	412271	-212562	-184999	-204140	41694	-45835	22134	240687	-959344

Key External Policy Variables	Change	Growth
Collections Change	(3.5%)	0.035
Disbursements Change	2.5%	0.025

Collections Assumptions	Disbursements Assumptions
Pessimistic 1,134,129.00	Pessimistic 1,302,482.00
Most Likely 1,537,154.00	Most Likely 1,595,394.00
Optimistic 1,836,081.00	Optimistic 2,035,727.00

Figure 5.10 Simple ASN (FM&C) Probabilistic Model

As discussed earlier, the pessimistic, most likely and optimistic values can be determined for each month's collections and disbursements. Using these assumptions, distributions can be established for the actual monthly transactions, as in Figure 5.7. Similarly, distributions can be established for the external variables on the lower left of the model; collections change and disbursements change, as in Figure 5.8. Equipped with these assumptions, a simulation can be run – that is, all possible combinations of different variable values and probabilities can be tested to arrive at a most likely solution. Upon completion of the simulation run, output is provided in report format, which is discussed in detail in the next section. In the model illustrated in Figure 5.10, the 1998 forecast collections appear the same as the 1997 actual collections. This occurs because the

probabilistic cell values (shaded – indicating cell assumptions have been defined) are *placeholders*, which are *reset* to the original values at the end of the simulation run.

Simulation software will provide a distribution of the possible outcomes from that simulation, allowing managers to determine ranges of possible outcomes with associated probabilities. First, select which outputs are to be forecasted. In the case of this model, Total Collections, Disbursements and Outlays have been chosen, based on mathematical formulas built in to account for the anticipated changes to the external variables (i.e. collections and disbursements growth and decline). *Crystal Ball*, a simulation software add-in to *Microsoft Excel*, was used to run a simulation of the simple model in Figure 5.10. A synopsis of that output is provided in Figure 5.11. A complete copy of the simulation output is provided as Appendix F.

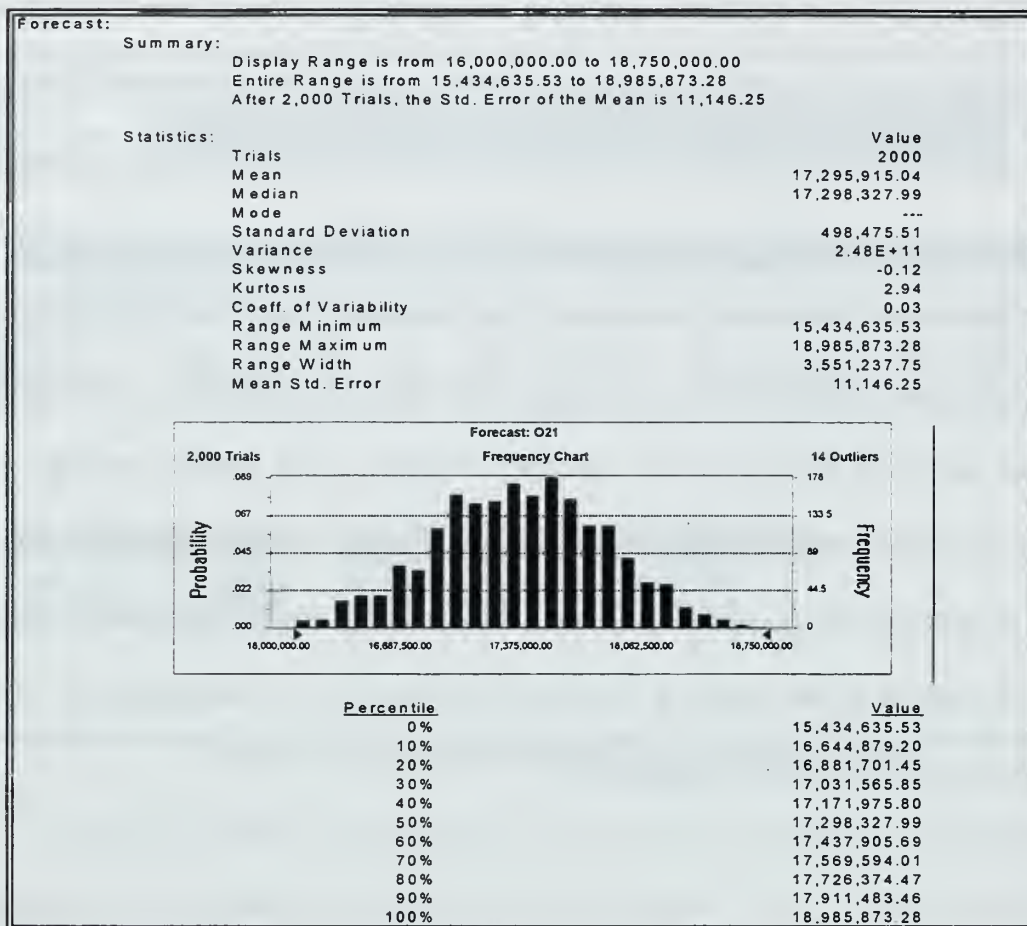


Figure 5.11 Summary Output of Simulation Run – Collections Forecast

The output from simulation provides the distribution of the outcome for the particular forecast displayed (i.e. collections). Separate summaries are provided for each forecasted variable. In this model forecasts for collections (Figure 5.11) and disbursements were specified. The outcomes are based on simulating all possible combinations of the variable distributions that were specified in the model. The *Summary* section provides the maximum and minimum expected outcomes for collections, based on the defined assumptions. The *Statistics* section provides the median – which is the most likely outcome for collections from this simulation - \$17,298,327.99.

The median also appears in the *Percentile* section at the 50 percent level, indicating the value that is most likely to appear in the distribution of outcomes, as illustrated by the graph. The most likely outcome falls in the middle of the graphical distribution curve, or close to the median of observed outcomes.

In other words, the simulation provides the manager with the complete range of possible collections for 1998, from the lowest (\$15,434,635) to the highest (\$18,985,873) monthly collections. As this is a rather wide range of estimates, other summary options can be selected that allow managers to determine the likelihood of achieving a defined amount of collections, or a range of collections. For example, a model user can specify a possible range of expected outcomes with an associated confidence level (e.g. 95 percent of the time collections will be between \$17,500,000 and \$18,100,000). This model can be easily expanded to accommodate additional variables. Additionally, assumptions about variables can be readily changed and simulations re-run to determine the effects on forecasted outputs.

2. Supply Management

The Supply Management Activity Group has employed an Expenditures forecasting model for nearly ten years. As mentioned earlier, the model was significantly revised in 1998, to reflect accounting changes and update software capabilities. The premise of the Supply Management Activity Group model is sound, although the new and improved model has yet to prove itself. Analysis of the model's operations, detailed in Chapter IV, reveals that a critical element in forecasting expenditures is the use of an

appropriate financial lead-time (FLT) by budget project (BP) to determine when obligated funds will ultimately expend. The focus of this section will be FLT selection for developing forecasts for budget submissions.

The current method for selecting BP FLTs for forecasting purposes involves the cash manager selecting an individual FLT based on recent months' computed FLTs. The annual forecast is developed based on this single point-in-time calculation. Actual data suggest that FLTs may vary significantly from month to month. Therefore, this model could be further improved by utilizing monthly *forecasted FLTs* to determine the next year's expenditures. The improvements include achieving a *monthly* vice *year-end* expenditure forecast, and utilizing a more realistic FLT to improve forecast accuracy.

As addressed earlier in this chapter, the BP FLT data demonstrates long-term trends over time. The observed trends can be *modeled* using regression analysis, as described in Chapter III, to develop algebraic equations representative of the trend line. Figure 5.12 was developed by regressing the FLT data over time and plotting the results against calculated FLTs.

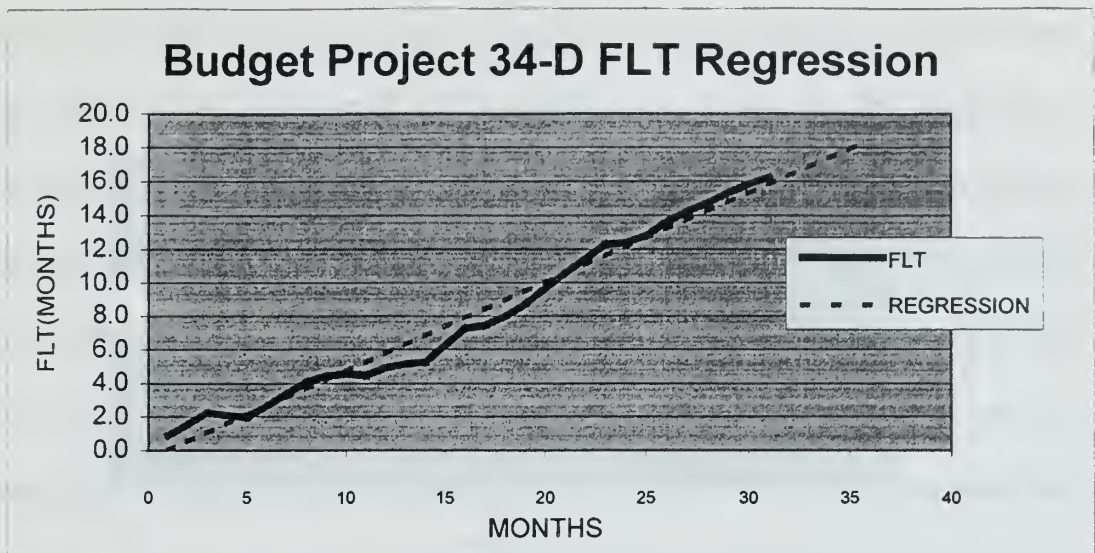


Figure 5.12 Regression Chart of Budget Project 34-D FLT

In this example, the trend line “fits” the actual observations with great accuracy. This is not the case for all BPs, but nearly half demonstrate trend patterns with “fit” that is better than 80 percent accurate. Monthly forecasted FLT’s can be incorporated in the expenditure forecasting model to enable forecasting expenditures on a monthly basis using a monthly forecasted FLT, instead of an annual forecast that employs a single FLT.

At this point in time it is difficult to determine the source of the long term trend in the FLT’s; however, recent FLT data in some of the BPs show a “leveling off” of the upward trend, as illustrated in Figure 5.13, perhaps indicating a stabilization in FLT’s.

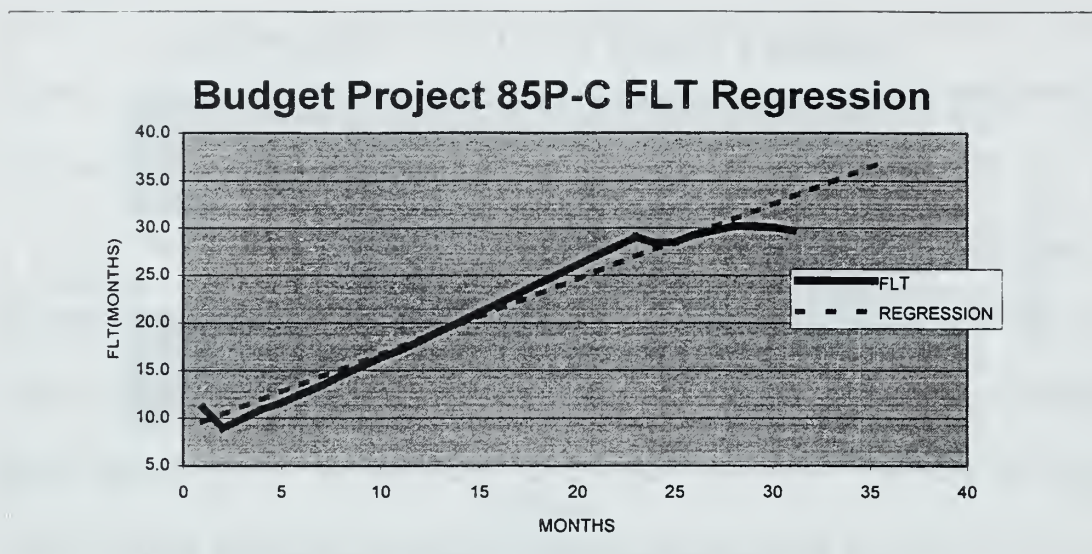


Figure 5.13 Budget Project 85P-D FLT Trend

Perhaps this change in pattern is due to the “two population” problem; that is, something has occurred in the system to cause the data pattern to shift. In this case, as well as in the case of the BP FLTs that show no trend, the best estimate of FLT would be the most recent months’ FLTs. Regardless of which method is used, this model could be improved by using monthly FLT predictions rather than the single FLT estimate that is currently used to forecast expenditures.

3. Activity Groups

The expenditures forecasting model used by the Supply Management Activity Group (NWCF-SM) is inappropriate for use in the remaining NWCF activity groups. Although the NWCF-SM has been used to represent the activity group level of the NWCF, the NWCF-SM is unique in that there is a significant lag from the obligation of funds to the expenditure of those funds. The primary cause of the lag is the nature of the activity group’s primary business – purchasing material for sale to customers. As stated

in Chapter II, the NWCF-SM buys large quantities of material, often on phased delivery contracts, which result in “stretched out” payments, or expenditures. The majority of fund obligations in the other NWCF activity groups are for *labor* requirements to support their business practices (i.e. providing services). Labor obligations expend within one to two months, whereas most of the NWCF-SM obligations for material purchases take eight or more months to expend. This unique lag is what originally drove the implementation of an expenditure forecasting model in the NWCF-SM. The expenditure forecasting model is, therefore, inappropriate for application in the other activity groups.

The budget and execution tasks of the other NWCF activity groups’ managers could be better served with a *probabilistic version* of the currently *deterministic* ASN (FM&C) model that is in development. As was stated in Chapter II, activity group managers are the link between ASN (FM&C) and NWCF activities, compiling budget submissions and monitoring execution. The activity group budget forecasts are therefore only as good as the forecasts prepared and submitted by their respective activities. The best way to improve activity group forecast accuracy is to improve activity forecasts. Additionally, the most efficient way for activity group managers to report budget and execution data to ASN (FM&C) is for all activity group managers to submit budget information in the same format that is also easily compiled by ASN (FM&C). Thus, ASN (FM&C)’s effort to automate activity group budget submissions is a step towards improved efficiency in data collection. Similarly, activity group managers could use the same data templates to compile and submit budgetary data from their activities.

Following this line of reasoning, the ASN (FM&C) cash reporting model could be used by activity group cash managers to collect data and produce reports. Additionally, the probabilistic features discussed earlier could improve activity group managers' decision analysis capabilities. The model used by activity group managers could be tailored in scope to track cash management data, and need not be much more complex than the model shown in Figure 5.9. Employing such a model at the activity group and activity level of the NWCF would result in greater accuracy and efficiency in cash reporting.

Activity groups could employ regression analysis as well, to analyze patterns that may exist in activity collection and disbursement transactions. Patterns, if they exist, can be recognized by graphically plotting the transactions against time. If patterns are found, these patterns can be modeled to quantitatively forecast future transactions. Trend analysis and simple regression can become additional tools for the activity comptroller to prepare budget submissions and predict future business patterns.

D. IMPLEMENTATION CONSIDERATIONS

Cost and simplicity are keys to effectively introducing a cash model at all levels of the NWCF. Initial costs can be minimized by restricting the scope of the model to only the most essential tasks - in this case, cash management and budget preparation/submission. Initially, only those variables common to all levels of the NWCF, collections and disbursements, should be tracked. Simplicity not only keeps

costs low, but also increases the likelihood that the model will be used. Other considerations include availability of data and compatibility with existing software and systems. Data sources vary at different levels of the NWCF, and balances may require reconciliation. When a simple model is functional at all levels, the next step would be to upgrade the model to include more variables and forecasting capabilities.

1. Distribution and Consistency

A first step to distributing the model could be accomplished in the same manner as the budget submission template was introduced by ASN (FM&C), by forwarding the model to activity group managers for use in budget submission and cash reporting. When this step is completed, the model could be introduced at the activity level to completely automate the budget submission process. The last step would be to include forecasting tools in the model that provide trend analysis and regression capabilities.

2. Software Applications

Wherever possible, common software should be used in introducing a model. In the NWCF, the best bet would be software that is already in use – e.g. the Navy standard is *Microsoft Office*, which includes spreadsheet and database software that can accommodate modifications and add-ons for modeling and simulation. Simplicity remains paramount, for the more complex the software used becomes, the less likely it is that it will be used.

The ASN (FM&C) model in development is in *Microsoft Access* format, part of the *Microsoft Office* package. Regression analysis can be accomplished using *Excel*, and simulations can be run using an inexpensive add-in to *Excel*, *Crystal Ball*.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. SUMMARY

Sound cash management practices are critical to the success of the Navy Working Capital Fund. Accurate information about cash position equips NWCF managers with the tools necessary to make investment decisions and to properly establish future rates and prices. Failure to maintain good information about cash balances can lead to erratic pricing and surcharge swings that can have a significant and negative effect on the entire Navy budget. Attaining the goal of forecasting future cash balances is predicated on the ability to access quality information in a timely fashion. Currently, NWCF managers obtain cash information that is on average over 30 days old. In addition, the seemingly haphazard processing of transactions by the DFAS results in information that is often skewed and unreliable.

NWCF cash managers must have real time access to reliable cash balance information, as a multi-billion-dollar firm would expect. Until that time arrives, cash managers can develop and implement a user friendly cash reporting system that can be expanded to provide forecasting and analysis tools. Activity group managers and activity comptrollers should continue to apply their experience and knowledge of business practices to develop cash plans, but they should be provided simple quantitative analysis tools to aid in the decision making process.

A universal cash forecasting model is not likely within the NWCF, as business practices differ greatly among activity groups. However, there can be a universal reporting system, with later forecasting enhancements, to improve reporting consistency and accuracy in budget submissions. Additionally, a dedicated effort to improve the quality and timeliness of cash transaction information should vastly improve cash managers' forecasting capabilities in the future.

The methods described in this thesis will help to provide cash managers and comptrollers with basic quantitative skills in trend analysis and forecasting. The recommendations for model development are the means for NWCF cash managers to get started.

The remainder of this chapter answers the research questions developed in the first chapter and indicates potential areas for future research.

B. RESEARCH QUESTIONS

1. Can cash forecasting models be used, or developed, to improve current NWCF cash management practices? Research of the NWCF indicates that there are several cash models in use or development. A cash reporting system is in the prototype stages at ASN (FM&C). Three different models are used within the Supply Management Activity Group (NWCF-SM); one at NAVICP Philadelphia, one at NAVICP Mechanicsburg and one at the activity group level (NWCF-SM). This thesis focused on cash models in use at ASN (FM&C) and at NAVSUP. Research revealed the

models to be uniquely applied in their respective business areas to support cash management and, in the NAVSUP case, to forecast expenditures. In the 16 remaining NWCF activity groups, budgets are developed in a largely non-quantitative fashion, based on experience and anticipated workloads.

Two distinct approaches to forecasting were discussed in detail: regression analysis and simulation. These methods were practically applied to available NWCF-SM data and ASN (FM&C) data based on data quality and trend analysis.

In the NWCF-SM case, recommendations were made to improve the performance of the expenditure forecasting model based on trend regression analysis. Additionally statistical software and methods for developing and implementing these tools were discussed. This NWCF-SM model was found to be unique in application to the Supply Management Activity Group, although trend and regression analysis can improve decision-making ability in any NWCF business area.

The ASN (FM&C) cash data were not available for a sufficient length of time to discern trends in transactions. However, a developmental cash reporting system was found to meet many of the ASN (FM&C) cash manager's requirements for cash reporting. Additionally, recommended probabilistic enhancements to the currently deterministic model will provide increased decision analysis information.

2. What models are currently used to forecast cash balances in the NWCF Activity Groups and at ASN (FM&C)? As discussed above, several models

were found in use or development, although only one, the NWCF-SM expenditures forecasting model, actually employed quantitative techniques to forecast future transactions.

3. Are private sector companies with similar business activities using effective cash forecasting models? Can such models be applied in the NWCF?

Private sector companies do employ cash forecasting to better manage resources and improve investment decision-making. Several firms with similar business activities were contacted to assess their forecasting methods and capabilities. Directly accessing information was not possible, as the firms contacted deemed this information proprietary. Benchmarks were discovered, however, in trade publications; and several applications were discussed in detail. The models reviewed, however, were found to be uniquely developed and suited for the individual businesses. Most models, it seems, are developed from the ground up.

4. How effective are existing models in forecasting cash balances? The only NWCF forecasting model found had mixed reviews. It was fairly reliable until 1997, when a large variation in outlays occurred. A full assessment of the model's shortcomings and subsequent improvements was provided. Government audits universally indicate that cash balance forecasting must be improved in the service working capital funds.

5. What requirements exist for forecasting cash balances at the ASN (FM&C) and Activity Group levels of the NWCF? Interviews with cash managers at

ASN (FM&C) and NAVSUP indicated that accurate cash forecasting is currently in high demand. A literature review confirms this assessment.

6. Can an existing forecasting model be applied across all activity groups in the NWCF? The NAVSUP model and the private sector models discussed were all unique in application. Differing business practices in NWCF activity groups appear to preclude a universal forecasting model. However, a probabilistic cash management model could be applied across all activity groups to improve reporting and decision-making abilities.

7. Can the data available to NWCF AG's be used to develop other statistical analyses (SPC, moving averages, decomposition) or new forecasting models applicable to the NWCF? Data analysis showed that time series analysis, simple regression and simulation could be applied in the NWCF. All provide additional quantitative methods for analyzing cash transaction data.

8. Can effective cash management tools be implemented throughout the NWCF Activity Groups? Implementation of the ASN (FM&C) cash reporting system can improve cash management and accuracy in reporting. This system has already been used for activity group budget submissions, and it could be expanded to include simple probabilistic modeling and data analysis capabilities.

C. SUGGESTIONS FOR FURTHER RESEARCH

Based on arguments and facts presented in this thesis, the following recommendations are offered to provide Navy Working Capital Fund cash managers with better decision-making information and methods to better employ cash resources.

1. This thesis concentrated on forecasting and modeling at the ASN (FM&C) and Supply Management levels of NWCF cash management. Future research could focus on other areas for cash management budget forecasting (i.e. Shipyards, NADEPS) and other NWCF activity groups (i.e. Industrial, RDT&E). The ASN (FM&C) budget submission is only as good as the inputs received from the activities.

2. WCF cash management is a relatively new responsibility for the Navy. As such, the processes of data collection, cash plan development and monitoring execution may not be as efficient as possible. Future efforts could involve “mapping” NWCF cash management processes to highlight problem areas that could be improved or streamlined.

3. Currently, Antideficiency Act (31 U.S.C. 1517) responsibility for cash solvency resides at the ASN (FM&C) level of the NWCF. Pushing this responsibility down to the activity group and activity level is viewed as a possible way to increase cash consciousness and improve cash management. To date, however, the data available below the ASN (FM&C) level of the fund do not provide activity group managers and activity comptrollers the information necessary for effective cash management. What can be done to improve the quality and timeliness of information provided at the activity

manager and activity levels of the NWCF? What other problems stand in the way of pushing 1517 responsibility down to these levels?

4. The Defense Finance and Accounting Service (DFAS) currently provides NWCF cash managers with transaction data some 30 plus days after transactions have occurred. Additionally, it is extremely difficult to get the DFAS to provide customized reports that would improve cash managers abilities to forecast and monitor cash positions. "Data mining" is a term that refers to drawing specific data elements out of a large database in a customized format. What possibilities exist to apply this technology in "mining" NWCF cash management data out of DFAS? ASN (FM&C) currently receives a CD-ROM diskette from DFAS on a monthly basis that contains over 500,000 transactions that occurred in the previous month. ASN (FM&C) is researching ways to access and format the data into a usable format.

5. Is the OSD requirement to maintain 7-10 days cash realistic? If so, why are prices and rates set to achieve a net operating result of zero? Should pricing and rates be set to maintain a net operating result of 7-10 days of working capital? If 7-10 days is not realistic, what amount should be retained to maintain the ability to pay the bills?

APPENDIX A

Forecasting Methods

FORECASTING APPROACH	METHODS	SHORT DESCRIPTION
JUDGMENTAL	INDIVIDUAL JUDGMENT	INTUITIVE, AD HOC FORECASTS
	MULTIPLE ATTRIBUTE DECISION-MAKING	INVOLVES SPECIFIC SUBJECTIVE PROBABILITIES AND PREFERENCES
	COMMITTEES	GROUPS MEETING FACE-TO-FACE
	EXECUTIVE OPINION	EXECUTIVES MEET AND JOINTLY PREPARE FORECASTS
QUANTITATIVE TIME-SERIES	NAIVE	SIMPLE: FORECAST = ACTUAL, OR FORECAST = LAST YEAR'S
	DECOMPOSITION	DATA IS 'BROKEN DOWN' INTO PATTERNS OF TREND, SEASONALITY, CYCLIC AND RANDOMNESS
	SIMPLE TIME-SERIES	FORECASTS MADE BY AVERAGING (SMOOTHING) PAST ACTUAL DATA
	ADVANCED TIME-SERIES	FORECASTS ARE BASED ON COMBINATIONS OF PAST ACTUALS AND ERRORS
	EXPLANATORY	SIMPLE REGRESSION
		VARIATIONS IN THE FORECAST VARIABLE CAN BE EXPLAINED BY VARIATIONS IN ANOTHER VARIABLE
	MULTIPLE REGRESSION	VARIATIONS EXPLAINED BY VARIATIONS IN MORE THAN ONE OTHER VARIABLE
	ECONOMETRIC MODELS	SYSTEMS OF SIMULTANEOUS EQUATIONS. ACCOUNTS FOR INTERDEPENDENCE AMONG VARIABLES
	MULTIVARIATE METHODS	PREDICTIONS MADE USING A STATISTICAL APPROACH THROUGH ANALYSIS OF TIME-SERIES DATA
MONITORING	TRACKING SIGNALS	SIGNIFICANT FLUCTUATIONS ARE IDENTIFIED; A 'WARNING SIGNAL' IS GIVEN WHEN SIGNIFICANT

		FLUCTUATION OCCURS
TECHNOLOGICAL EXTRAPOLATION	DELPHI	SYSTEMATIC METHOD OF OBTAINING EXPERT OPINION, AVOIDS PROBLEMS ASSOCIATED WITH GROUP MEETINGS
	TREND EXTRAPOLATION	EXTRAPOLATES THE PREVAILING TENDENCY OF A SYSTEM
	SYSTEM DYNAMICS	DIFFERENTIAL EQUATIONS ARE USED TO MODEL THE FUTURE, BY EXTRAPOLATING LINEAR AND NON-LINEAR TRENDS/RELATIONSHIPS
NORMATIVE	CROSS IMPACT	FORECASTS BASED ON INTERDEPENDENCE AMONG FUTURE DEVELOPMENTS
	PATTERN	SYSTEMATIC METHOD OF FORECASTING USING PREFERENCES

APPENDIX B

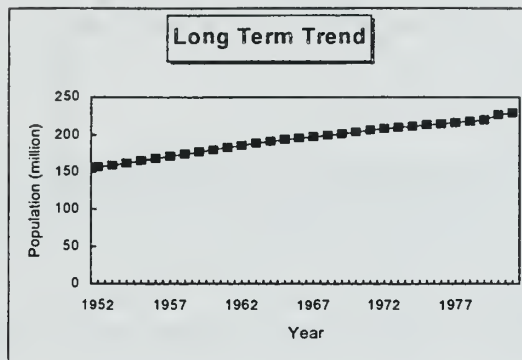


Figure 1 illustrates a *long-term trend*. Note the upward slope. A trend can be upward, downward or unchanged (no slope).

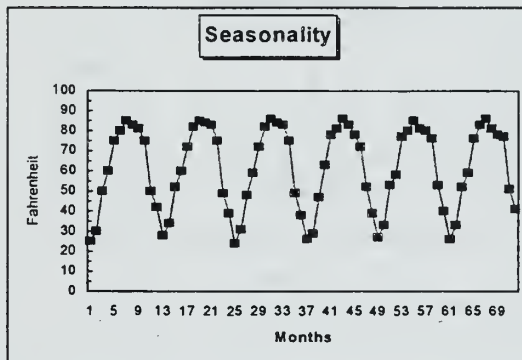


Figure 2 illustrates an example of a *seasonal pattern*. Note the constant length of the pattern, in this case 12 month periods.

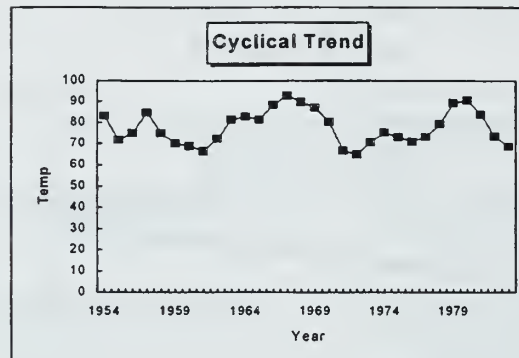


Figure 3 graphically illustrates a *cyclical pattern*. Note the varying length of the cyclic intervals, which are generally longer than a seasonal pattern.

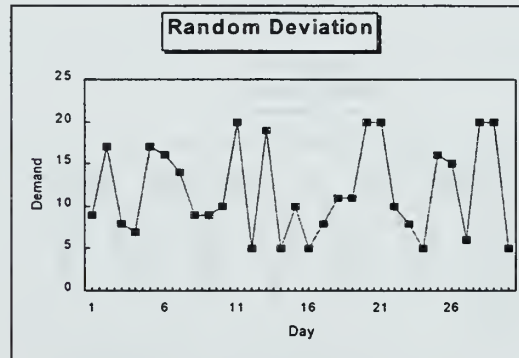


Figure 4 illustrates a *random pattern*. Note that these patterns can be described as fluctuating about their average. No pattern is discernable.

Figure 5
Electricity Consumption (1947-1955)

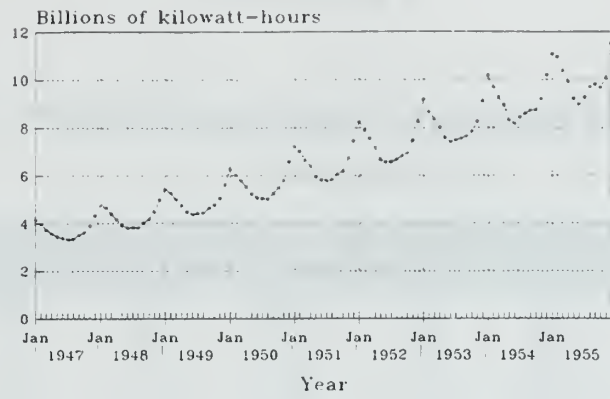


Figure 5 illustrates a time-series that includes *trend*, *seasonality* and to a lesser degree, *cyclical and random patterns*.

APPENDIX C

NAVY WORKING CAPITAL FUND

DATA ANALYSIS

SUPPLY ACTIVITY GROUP AGGREGATE									
PERIOD	DATE	PLAN EXP	ACT EXP	NTH EXP	PLAN COLL	ACT COLL	MNTH COLL	PLAN OUT	ACT OUT
1	Oct-89	689	689	689	338	338	338	350	350
2	Nov-89	1232	1232	543	1366	1366	1028	-134	-134
3	Dec-89	1781	1781	549	1915	1915	549	-134	-134
4	Jan-90	2351	2415	634	2484	2429	514	-134	-13
5	Feb-90	2972	3024	609	3125	3018	589	-153	6
6	Mar-90	3628	3633	609	3860	3653	635	232	21
7	Apr-90	4316	4226	593	4488	4333	680	172	107
8	May-90	4983	4933	707	5100	5119	786	-118	-186
9	Jun-90	5647	5530	597	5732	5527	408	-86	4
10	Jul-90	6279	6105	575	6334	6312	785	-55	-208
11	Aug-90	6909	6744	639	6969	7065	753	-60	-322
12	Sep-90	7598	7426	682	7707	7659	594	-109	-234
13	Oct-90	677	748	748	740	634	634	-63	114
14	Nov-90	1361	1552	804	1456	1444	810	-95	108
15	Dec-90	2275	2256	704	2309	2137	693	-34	88.4
16	Jan-91	3018	3003	747	3099	2935	798	-81	68
17	Feb-91	3878	3671	668	3915	3630	695	-37	41
18	Mar-91	4688	4552	881	4810	4453	823	-122	100
19	Apr-91	5582	5342	790	5650	5571	1118	-69	-229
20	May-91	6498	6136	794	6447	6241	670	51	-106
21	Jun-91	7263	6752	616	7296	7136	895	-33	-384
22	Jul-91	8031	7725	973	8226	8002	866	-195	-277
23	Aug-91	8804	8307	582	8828	8691	689	-24	-384
24	Sep-91	9341	9192	885	9253	9336	645	88	144
25	Oct-91	670	843	843	572	550	550	99	-293
26	Nov-91	1055	1493	650	1193	1167	617	-138	-327
27	Dec-91	1769	1989	496	1670	1766	599	99	-223
28	Jan-92	2471	2568	579	2325	2315	549	146	-253
29	Feb-92	3052	3159	591	2908	2665	350	144	-495
30	Mar-92	3787	3769	610	3534	3269	604	253	-501
31	Apr-92	4252	4283	514	4113	4335	1066	140	52
32	May-92	4863	4853	570	4689	4789	454	174	-63.2
33	Jun-92	5382	5357	504	5255	5457	668	128	100
34	Jul-92	6043	5949	592	5872	5927	470	171	-23
35	Aug-92	6567	6542	593	6514	6610	683	53	67
36	Sep-92	7323	7115	573	7212	7196	586	111	81
37	Oct-92	560	594	594	461	428	428	99	165
38	Nov-92	1075	1068	474	953	909	481	122	159

APPENDIX D

DoN NWCF Cash Forecast By Month 1998

ALL	ALL	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Total
A Revenue	Cumulative	1,324,641	1,474,634	1,633,590	1,675,491	1,690,917	1,942,072	1,801,952	1,571,754	1,886,101	1,926,154	2,063,340	2,359,063	21,349,709
		1,324,641	2,799,275	4,432,865	6,108,356	7,799,273	9,741,345	11,543,297	13,115,051	15,001,152	16,927,306	18,990,646	21,349,709	
B Expense	Cumulative	1,260,740	1,399,401	1,669,510	1,598,092	1,601,269	1,915,075	1,724,289	1,393,708	1,802,168	1,836,412	1,934,797	2,336,164	20,471,625
		1,260,740	2,660,141	4,329,651	5,927,743	7,529,012	9,444,087	11,168,376	12,562,084	14,364,252	16,200,664	18,135,461	20,471,625	
C. Net Operating Result	Cumulative:	63,901	75,233	-35,920	77,399	89,648	26,997	77,663	178,046	83,933	89,742	128,543	22,899	878,084
		63,901	139,134	103,214	180,613	270,261	297,258	374,921	552,967	636,900	726,642	855,185	878,084	
Total Collections Delta	Cumulative	19,131	8,086	173	3,476	-2	262,250	-8,734	12,470	-350	17,517	-427,200	1,905,600	-113,183
		1,442,494	1,733,555	1,544,354	1,415,722	1,421,951	2,029,848	1,722,457	1,490,421	1,829,955	1,664,927	1,792,630	1,905,600	19,993,914
		28,738	26,466	49,168	39,655	39,779	45,668	41,186	42,161	48,919	41,072	53,577	60,612	517,001
2 Cash Surcharge (DON)	Cumulative	36,130	11,360	33,037	26,517	18,827	573,449	44,029	52,821	-76,645	-771	143,009	85,518	947,281
		1,526,493	1,779,467	1,626,732	1,485,370	1,480,555	2,911,215	1,798,938	1,597,873	1,801,879	1,722,745	1,562,016	2,051,730	21,345,013
3 Other	Cumulative	1,526,493	3,305,960	4,932,692	6,418,062	7,898,617	10,809,832	12,608,770	14,206,643	16,008,522	17,731,267	19,293,283	21,345,013	
Total Disbursements Delta	Cumulative	19,061	8,032	-312	20,388	14,081	530,314	-5,456	22,405	13,831	206,723	-427,750	572,607	401,317
		720,307	484,394	485,566	494,108	496,581	504,479	502,045	692,878	537,201	498,757	544,090	572,607	6,533,013
		583,737	523,748	510,011	528,590	558,416	556,802	608,446	588,979	606,186	664,345	548,830	689,539	6,967,629
Capital Program	Cumulative	517,846	408,329	469,279	459,581	477,486	460,924	451,174	466,109	485,715	485,715	464,561	454,055	5,587,461
		15,591	14,962	20,501	16,469	17,048	21,229	23,715	13,363	26,281	22,694	26,267	31,422	249,542
		60,286	57,882	78,874	41,264	54,129	59,275	57,367	56,587	61,440	61,155	76,448	53,490	718,197
Utilities/Communications	Cumulative	114,718	48,703	18,623	46,722	70,838	-73,061	103,418	105,722	61,129	26,283	158,417	158,088	839,600
		2,031,546	1,546,050	1,582,542	1,607,122	1,688,579	2,071,440	1,750,459	1,931,108	1,772,177	1,965,672	1,390,863	1,959,201	21,296,759
6 Other Disbursements	Cumulative	2,031,546	3,577,596	5,160,138	6,767,260	8,455,839	10,527,279	12,277,738	14,208,846	15,981,023	17,946,695	19,337,558	21,296,759	
C Net Outlays	Cumulative	505,053	-233,417	-44,190	121,752	208,024	-839,775	-48,479	333,235	-29,702	242,927	-171,153	-92,529	-48,254
		505,053	271,636	227,446	349,198	557,222	-282,553	-331,032	2,203	-27,499	215,428	44,275	-48,254	
D Transfers	Cumulative	-9,834	-9,835	28,039	-79,150	-9,834	-9,834	-9,834	-9,834	104,840	96,740	-23	49,466	140,907
		-9,834	-19,669	8,370	-70,780	-80,614	-90,448	-100,282	-110,116	-5,276	91,464	91,441	140,907	
Beginning AB Balance	Cumulative	638,092	568,868	885,183	800,441	748,645	720,737	905,918	742,714	624,448	512,864	430,712	344,008	
		0	461,751	35,797	61,295	101,656	290,888	0	0	0	0	0	2,621	
		-69,224	-145,436	-120,539	-113,091	-129,564	-105,707	-163,204	-118,266	-111,584	-82,152	-86,704	-71,551	
ASN(FM&C)-Directed AB Balance	Cumulative	568,868	885,183	800,441	748,645	720,737	905,918	742,714	624,448	512,864	430,712	344,008	275,078	
Beginning CashBalance	Cumulative	746,520	231,633	455,215	527,444	326,542	108,684	938,625	977,270	634,201	768,743	622,556	793,686	
		505,053	-233,417	-44,190	121,752	208,024	-839,775	-48,479	333,235	-29,702	242,927	-171,153	-92,529	
		-9,834	-9,835	28,039	-79,150	-9,834	-9,834	-9,834	-9,834	104,840	96,740	-23	49,466	
D Transfers	Cumulative	231,633	455,215	527,444	326,542	108,684	938,625	977,270	634,201	768,743	622,556	793,686	935,681	

APPENDIX E

BP 34-P REGRESSION

FLT	X-VALUE	FORECAST FLT	SUMMARY OUTPUT
Oct		1	-3.113
Nov		2	-2.536
Dec	0.2	3	-1.959
Jan	0.1	4	-1.382
Feb	0.1	5	-0.805
Mar	0.3	6	-0.228
Apr	0.5	7	0.349
May	1.0	8	0.926
Jun	1.4	9	1.503
Jul	1.6	10	2.08
Aug	1.7	11	2.657
Sep	0.9	12	3.234
Oct	1.7	13	3.811
Nov	2.5	14	4.388
Dec	3.5	15	4.965
Jan	4.5	16	5.542
Feb	5.5	17	6.119
Mar	6.5	18	6.696
Apr	7.4	19	7.273
May	8.4	20	7.85
Jun	9.3	21	8.427
Jul	10.1	22	9.004
Aug	10.9	23	9.581
Sep	11.1	24	10.158
Oct	11.5	25	10.735
Nov	12.0	26	11.312
Dec	12.2	27	11.889
Jan	12.6	28	12.466
Feb	13.3	29	13.043
Mar	13.5	30	13.62
Apr	12.9	31	14.197
May	0.0	32	14.774
Jun	0.0	33	15.351
Jul	0.0	34	15.928
Aug	0.0	35	16.505
Sep	0.0	36	17.082

Regression Statistics

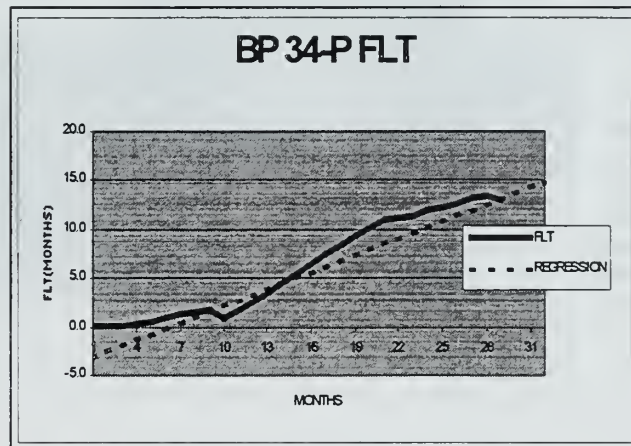
Multiple R	0.97561
R Square	0.95181
Adjusted R	0.95003
Standard	1.1249
Observati	29

ANOVA

	df	SS	MS	F	Significance F
Regression	1	674.866	674.866	533.325	2.6E-19
Residual	27	34.1657	1.26539		
Total	28	709.032			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-3.6874	0.47306	-7.7948	2.2E-08	-4.658	-2.7167	-4.658	-2.7167
X Variable	0.57658	0.02497	23.0938	2.6E-19	0.52535	0.62781	0.52535	0.62781

THE REGRESSION EQUATION IS $-3.69 + .577X$



FLT	X-VALUE	FORECAST FLT
Oct	0.9	1 -0.023
Nov	1.6	2 0.504
Dec	2.2	3 1.031
Jan	2.1	4 1.558
Feb	2.0	5 2.085
Mar	2.7	6 2.612
Apr	3.4	7 3.139
May	4.1	8 3.666
Jun	4.4	9 4.193
Jul	4.6	10 4.72
Aug	4.5	11 5.247
Sep	4.9	12 5.774
Oct	5.2	13 6.301
Nov	5.3	14 6.828
Dec	6.3	15 7.355
Jan	7.3	16 7.882
Feb	7.4	17 8.409
Mar	8.0	18 8.936
Apr	8.7	19 9.463
May	9.7	20 9.99
Jun	10.6	21 10.517
Jul	11.4	22 11.044
Aug	12.3	23 11.571
Sep	12.4	24 12.098
Oct	12.8	25 12.625
Nov	13.6	26 13.152
Dec	14.2	27 13.679
Jan	14.7	28 14.206
Feb	15.3	29 14.733
Mar	15.8	30 15.26
Apr	16.2	31 15.787
May	0.0	32 16.314
Jun	0.0	33 16.841
Jul	0.0	34 17.368
Aug	0.0	35 17.895
Sep	0.0	36 18.422

SUMMARY OUTPUT

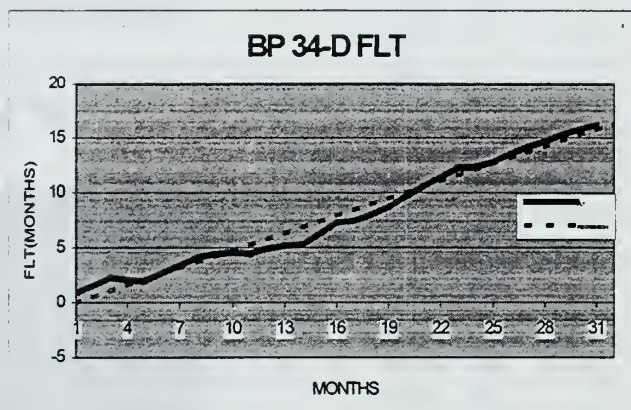
Regression Statistics	
Multiple R	0.98899
R Square	0.978101
Adjusted R	0.977345
Standard E	0.729525
Observatio	31

ANOVA

	df	SS	MS	F	gnificance F
Regression	1	689.3345	689.3345	1295.24	1.28E-25
Residual	29	15.43398	0.532206		
Total	30	704.7685			

	Coefficients	standard Error	t Stat	P-value	ower 95%	pper 95%
Intercept	-0.553181	0.268524	-2.060078	0.048465	-1.102375	-0.003987
X Variable	0.527217	0.014649	35.98944	1.28E-25	0.497256	0.557178

THE REGRESSION EQUATION IS $-.55 + .527X$



BP 85R-Z REGRESSION

	EST FLT	X-VALUE	FORECAST FLT
Oct		1	-9.242
Nov		2	-8.274
Dec		3	-7.306
Jan		4	-6.338
Feb		5	-5.37
Mar		6	-4.402
Apr		7	-3.434
May		8	-2.466
Jun		9	-1.498
Jul		10	-0.53
Aug	0.5	11	0.438
Sep	1.4	12	1.406
Oct	2.4	13	2.374
Nov	3.3	14	3.342
Dec	4.3	15	4.31
Jan	5.3	16	5.278
Feb	6.3	17	6.246
Mar	7.2	18	7.214
Apr	8.2	19	8.182
May	0.0	20	9.15
Jun	0.0	21	10.118
Jul	0.0	22	11.086
Aug	0.0	23	12.054
Sep	0.0	24	13.022

SUMMARY OUTPUT

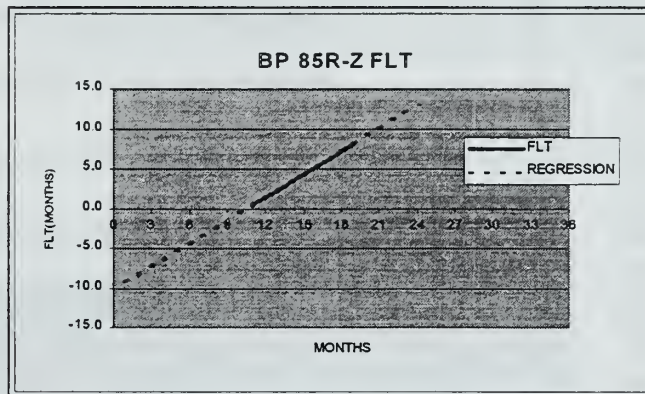
Regression Statistics	
Multiple R	0.999985
R Square	0.99997
Adjusted R	0.999966
Standard E	0.015526
Observation	9

ANOVA

	df	SS	MS	F	Significance F
Regression	1	56.21021	56.21021	233179.1	4.31E-17
Residual	7	0.001687	0.000241		
Total	8	56.2119			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-10.20526	0.030508	-334.5071	5.63E-16	-10.2774	-10.13312	-10.2774	-10.13312
X Variable	0.967903	0.002004	482.8862	4.31E-17	0.963164	0.972643	0.963164	0.972643

THE REGRESSION EQUATION IS $-10.21 + .968X$



BP 85R-MP REGRESSION

EST FLT X-VALUE FORECAST FLT

Oct		1	-7.5
Nov		2	-6.6
Dec		3	-5.6
Jan		4	-4.7
Feb		5	-3.7
Mar		6	-2.8
Apr		7	-1.8
May		8	-0.8
Jun		9	0.1
Jul	0.9	10	1.1
Aug	1.9	11	2.0
Sep	2.9	12	3.0
Oct	3.9	13	3.9
Nov	4.9	14	4.9
Dec	5.9	15	5.9
Jan	6.9	16	6.8
Feb	7.9	17	7.8
Mar	8.8	18	8.7
Apr	9.8	19	9.7
May	10.7	20	10.6
Jun	11.7	21	11.6
Jul	12.7	22	12.5
Aug	13.6	23	13.5
Sep	14.5	24	14.5
Oct	15.4	25	15.4
Nov	16.3	26	16.4
Dec	17.3	27	17.3
Jan	18.3	28	18.3
Feb	19.2	29	19.2
Mar	20.1	30	20.2
Apr	21.1	31	21.1
May	22.1	32	22.1
Jun	0.0	33	23.1
Jul	0.0	34	24.0
Aug	0.0	35	25.0
Sep	0.0	36	25.9

SUMMARY OUTPUT

Regression Statistics

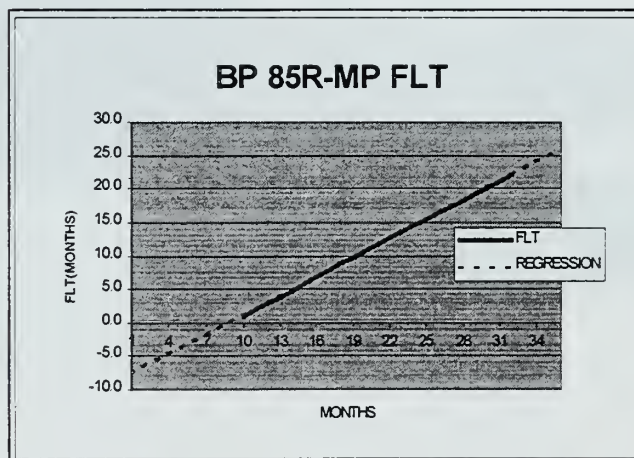
Multiple R	0.999919
R Square	0.999838
Adjusted R	0.99983
Standard E	0.084592
Observation	23

ANOVA

	df	SS	MS	F	Significance F
Regression	1	925.5732	925.5732	129344.4	2.79E-41
Residual	21	0.150274	0.007156		
Total	22	925.7235			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-8.487145	0.068662	-124.927	5.38E-33	-8.608931	-8.36536	-8.608931	-8.36536
X Variable	0.955346	0.002659	359.6448	2.79E-41	0.950816	0.961876	0.950816	0.961876

THE REGRESSION EQUATION IS $-8.49 + .956X$



BP 85R-G REGRESSION

EST FLT X-VALUE FORECAST FLT

Oct	7.4	1	5.038
Nov	7.9	2	5.486
Dec	6.4	3	5.934
Jan	6.5	4	6.382
Feb	6.3	5	6.83
Mar	5.9	6	7.278
Apr	6.1	7	7.726
May	6.4	8	8.174
Jun	6.7	9	8.622
Jul	7.1	10	9.07
Aug	7.6	11	9.518
Sep	8.6	12	9.966
Oct	9.6	13	10.414
Nov	10.6	14	10.862
Dec	11.5	15	11.31
Jan	12.4	16	11.758
Feb	13.3	17	12.206
Mar	14.2	18	12.654
Apr	15.0	19	13.102
May	15.6	20	13.55
Jun	16.2	21	13.998
Jul	16.7	22	14.446
Aug	16.9	23	14.894
Sep	16.0	24	15.342
Oct	15.8	25	15.79
Nov	15.5	26	16.238
Dec	15.5	27	16.686
Jan	16.1	28	17.134
Feb	16.5	29	17.582
Mar	17.0	30	18.03
Apr	17.4	31	18.478
May	0.0	32	18.926
Jun	0.0	33	19.374
Jul	0.0	34	19.822
Aug	0.0	35	20.27
Sep	0.0	36	20.718

SUMMARY OUTPUT

Regression Statistics

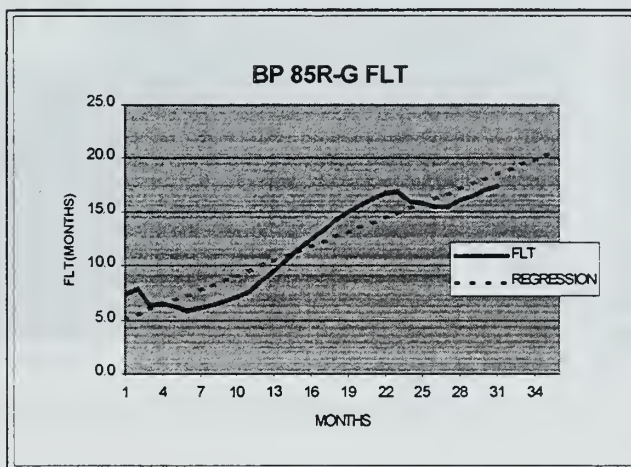
Multiple R	0.939067
R Square	0.881846
Adjusted R	0.877772
Standard E	1.517385
Observation	31

ANOVA

	df	SS	MS	F	Significance F
Regression	1	498.3491	498.3491	216.4422	5.53E-15
Residual	29	66.77127	2.302457		
Total	30	565.1203			

	Coefficients	Standard Error	t Stat	P-value	over 98%	ppor 98%	over 95.0%	ppor 95.0%
Intercept	4.587818	0.558821	8.214224	4.67E-09	3.445513	5.730122	3.445513	5.730122
X Variable	0.448271	0.03047	14.71198	5.53E-15	0.385954	0.510589	0.385954	0.510589

THE REGRESSION EQUATION IS $4.59 + .448X$



BP 85P-Z REGRESSION

EST FLT X-VALUE FORECAST FLT

0.3	1	-0.467
1.2	2	0.091
2.0	3	0.649
1.9	4	1.207
2.4	5	1.765
2.9	6	2.323
3.5	7	2.881
3.8	8	3.439
3.8	9	3.997
4.2	10	4.555
4.3	11	5.113
4.3	12	5.671
4.7	13	6.229
4.9	14	6.787
5.9	15	7.345
6.9	16	7.903
7.7	17	8.461
8.6	18	9.019
9.5	19	9.577
10.3	20	10.135
10.7	21	10.693
11.0	22	11.251
11.8	23	11.809
12.0	24	12.367
12.6	25	12.925
13.5	26	13.483
14.5	27	14.041
15.4	28	14.599
16.2	29	15.157
16.9	30	15.715
17.3	31	16.273
0.0	32	16.831
0.0	33	17.389
0.0	34	17.947
0.0	35	18.505
0.0	36	19.063

SUMMARY OUTPUT

Regression Statistics

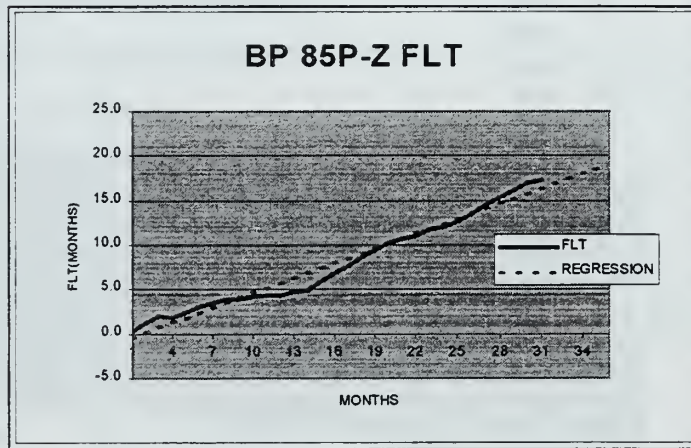
Multiple R	0.985394
R Square	0.971001
Adjusted R	0.970001
Standard E	0.891522
Observation	31

ANOVA

	df	SS	MS	F	Significance F
Regression	1	771.7883	771.7883	971.0328	7.54E-24
Residual	29	23.04954	0.794812		
Total	30	794.8379			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-1.024794	0.328153	-3.122918	0.004037	-1.695942	-0.353646	-1.695942	-0.353646
X Variable	0.557857	0.017902	31.1614	7.54E-24	0.521243	0.594472	0.521243	0.594472

THE REGRESSION EQUATION IS $-1.025 + .558X$



BP 85P-PR REGRESSION

EST FLT	X-VALUE	FORECAST FLT
Oct		1 -4.236
Nov		2 -3.552
Dec		3 -2.868
Jan		4 -2.184
Feb		5 -1.5
Mar		6 -0.816
Apr		7 -0.132
May		8 0.552
Jun	0.5	9 1.236
Jul	1.4	10 1.92
Aug	2.3	11 2.604
Sep	3.1	12 3.288
Oct	4.0	13 3.972
Nov	5.0	14 4.656
Dec	6.0	15 5.34
Jan	7.0	16 6.024
Feb	8.0	17 6.708
Mar	8.8	18 7.392
Apr	9.2	19 8.076
May	8.6	20 8.76
Jun	7.9	21 9.444
Jul	8.8	22 10.128
Aug	9.8	23 10.812
Sep	10.7	24 11.496
Oct	11.7	25 12.18
Nov	12.6	26 12.864
Dec	13.4	27 13.548
Jan	14.4	28 14.232
Feb	15.2	29 14.916
Mar	16.1	30 15.6
Apr	17.0	31 16.284
May	0.0	32 16.968
Jun	0.0	33 17.652
Jul	0.0	34 18.336
Aug	0.0	35 19.02
Sep	0.0	36 19.704

SUMMARY OUTPUT

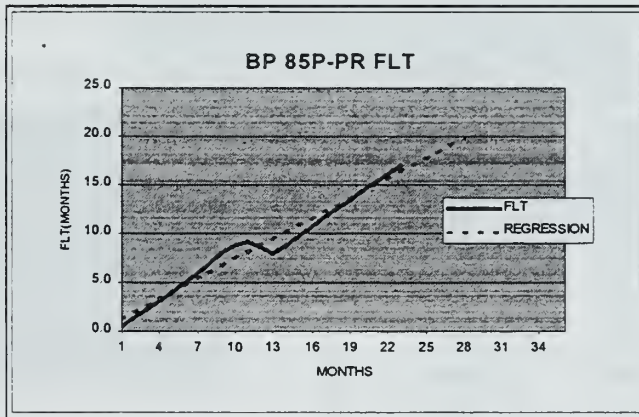
Regression Statistics	
Multiple R	0.98544
R Square	0.971092
Adjusted R	0.969715
Standard E	0.819684
Observation	23

ANOVA

	df	SS	MS	F	Significance F
Regression	1	473.9714	473.9714	705.439	1.21E-17
Residual	21	14.10951	0.671882		
Total	22	488.0809			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	-4.924398	0.542935	-9.069964	1.04E-08	-6.053493	-3.795304	-6.053493	-3.795304
X Variable	0.684362	0.025767	26.5601	1.21E-17	0.630777	0.737946	0.630777	0.737946

THE REGRESSION EQUATION IS $-4.92 + 0.684X$



BP 85P-G REGRESSION

	EST.FLT	X-VALUE	FORECAST.FLT
Oct	6.8	1	10.481
Nov	7.8	2	11.162
Dec	14.9	3	11.843
Jan	14.0	4	12.524
Feb	14.3	5	13.205
Mar	14.7	6	13.886
Apr	15.1	7	14.567
May	14.4	8	15.248
Jun	14.8	9	15.929
Jul	15.2	10	16.61
Aug	15.8	11	17.291
Sep	16.6	12	17.972
Oct	17.4	13	18.653
Nov	18.3	14	19.334
Dec	19.3	15	20.015
Jan	20.2	16	20.696
Feb	21.2	17	21.377
Mar	22.2	18	22.058
Apr	23.2	19	22.739
May	24.1	20	23.42
Jun	25.1	21	24.101
Jul	26.0	22	24.782
Aug	26.9	23	25.463
Sep	26.8	24	26.144
Oct	25.9	25	26.825
Nov	26.4	26	27.506
Dec	26.4	27	28.187
Jan	26.7	28	28.868
Feb	27.2	29	29.549
Mar	27.5	30	30.23
Apr	26.8	31	30.911
May	0.0	32	31.592
Jun	0.0	33	32.273
Jul	0.0	34	32.954
Aug	0.0	35	33.635
Sep	0.0	36	34.316

SUMMARY OUTPUT

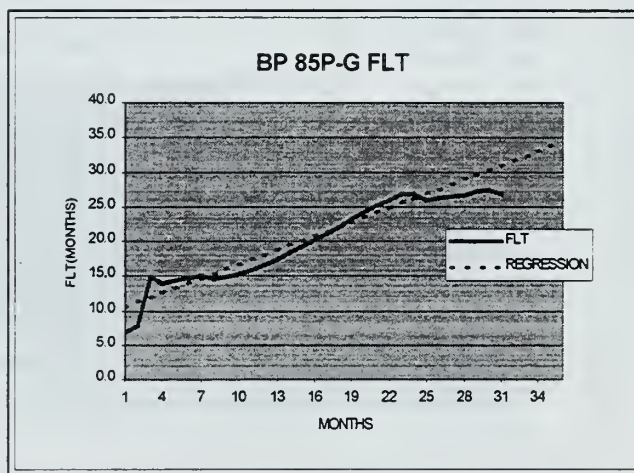
Regression Statistics	
Multiple R	0.953753
R Square	0.928821
Adjusted R	0.926366
Standard E	1.640523
Observation	31

ANOVA

	df	SS	MS	F	Significance F
Regression	1	1018.453	1018.453	378.4219	3.48E-18
Residual	29	78.0482	2.691317		
Total	30	1096.501			

	Coefficients	Standard Error	t Stat	P-value	over 95%	ppp 95%	over 95.0%	ppp 95.0%
Intercept	9.811628	0.603846	16.24865	4.2E-16	8.5/6623	11.0/663	8.5/6623	11.0/663
X Variable	0.640633	0.032943	19.45307	3.48E-18	0.573458	0.708208	0.573458	0.708208

THE REGRESSION EQUATION IS $9.8 + .641X$



Regression Statistics

Multiple R	0.971147
R Square	0.943127
Adjusted R	0.941166
Standard E	1.579322
Observatio	31

BP 85P-D REGRESSION

ANOVA

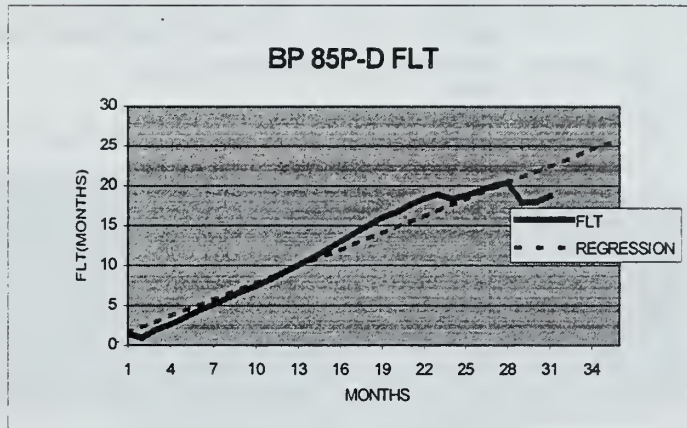
	df	SS	MS	F	ignificance F
Regression	1	1199.513	1199.513	480.9094	1.33E-19
Residual	29	72.33351	2.494259		
Total	30	1271.846			

EST FLT X-VALUE FORECAST FLT

Oct	1.5	1	1.565
Nov	1.0	2	2.26
Dec	1.9	3	2.955
Jan	2.6	4	3.65
Feb	3.5	5	4.345
Mar	4.4	6	5.04
Apr	5.1	7	5.735
May	6.0	8	6.43
Jun	6.8	9	7.125
Jul	7.5	10	7.82
Aug	8.3	11	8.515
Sep	9.2	12	9.21
Oct	10.1	13	9.905
Nov	11.0	14	10.6
Dec	12.0	15	11.295
Jan	13.0	16	11.99
Feb	14.1	17	12.685
Mar	15.0	18	13.38
Apr	16.0	19	14.075
May	16.7	20	14.77
Jun	17.7	21	15.465
Jul	18.4	22	16.16
Aug	18.9	23	16.855
Sep	18.4	24	17.55
Oct	18.7	25	18.245
Nov	19.4	26	18.94
Dec	20.0	27	19.635
Jan	20.4	28	20.33
Feb	17.9	29	21.025
Mar	18.0	30	21.72
Apr	18.7	31	22.415
May	0.0	32	23.11

	Coefficients	andard Error	t Stat	P-value	ower 95%	pper 95%	ower 95.0%	pper 95.0%
Intercept	0.872131	0.581319	1.500262	0.144356	-0.316801	2.061062	-0.316801	2.061062
X Variable	0.695467	0.031714	21.92965	1.33E-19	0.630606	0.760329	0.630606	0.760329

THE REGRESSION EQUATION IS $.87 + 0.695X$



BP 85P-C REGRESSION

EST FLT X-VALUE FORECAST FLT

Oct	11.1	1	9.579
Nov	9.0	2	10.368
Dec	10.0	3	11.157
Jan	10.9	4	11.946
Feb	11.6	5	12.735
Mar	12.6	6	13.524
Apr	13.4	7	14.313
May	14.5	8	15.102
Jun	15.4	9	15.891
Jul	16.4	10	16.68
Aug	17.2	11	17.469
Sep	18.2	12	18.258
Oct	19.1	13	19.047
Nov	20.1	14	19.836
Dec	21.1	15	20.625
Jan	22.1	16	21.414
Feb	23.1	17	22.203
Mar	24.1	18	22.992
Apr	25.1	19	23.781
May	26.1	20	24.57
Jun	27.1	21	25.359
Jul	28.0	22	26.148
Aug	29.0	23	26.937
Sep	28.4	24	27.726
Oct	28.5	25	28.515
Nov	29.3	26	29.304
Dec	29.7	27	30.093
Jan	30.2	28	30.882
Feb	30.2	29	31.671
Mar	30.1	30	32.46
Apr	29.7	31	33.249
May	0.0	32	34.038
Jun	0.0	33	34.827
Jul	0.0	34	35.616
Aug	0.0	35	36.405
Sep	0	36	37.194

SUMMARY OUTPUT

Regression Statistics

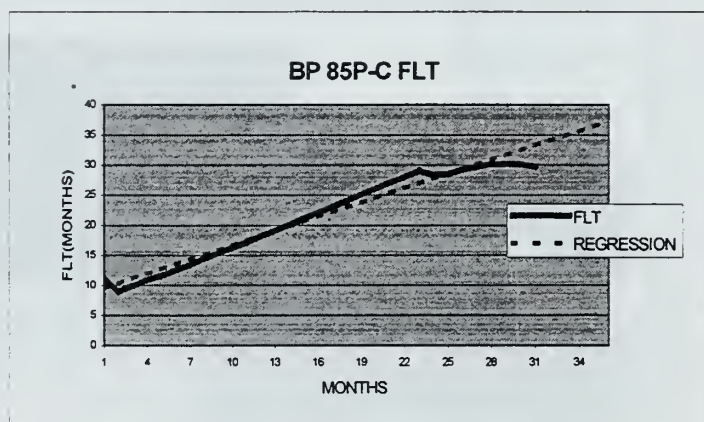
Multiple R	0.984295
R Square	0.968837
Adjusted R	0.967762
Standard E	1.308121
Observatio	31

ANOVA

	df	SS	MS	F	ignificance F
Regression	1	1542.76	1542.76	901.5761	2.14E-23
Residual	29	49.62424	1.711181		
Total	30	1592.384			

	Coefficients	andard Error	t Stat	P-value	ower 95%	pper 95%	ower 95.0%	pper 95.0%
Intercept	8.709051	0.481495	18.08752	2.46E-17	7.724283	9.693819	7.724283	
X Variable	0.788721	0.026268	30.02626	2.14E-23	0.734997	0.842444	0.734997	

THE REGRESSION EQUATION IS $8.709 + .789X$



BP 38 REGRESSION

EST FLT X-VALUE FORECAST FLT

Oct	3.5	1	3.432
Nov	3.7	2	3.394
Dec	4.1	3	3.356
Jan	4.5	4	3.318
Feb	2.5	5	3.28
Mar	2.0	6	3.242
Apr	2.6	7	3.204
May	3.2	8	3.166
Jun	4.0	9	3.128
Jul	2.4	10	3.09
Aug	2.4	11	3.052
Sep	2.2	12	3.014
Oct	2.6	13	2.976
Nov	3.0	14	2.938
Dec	3.5	15	2.9
Jan	2.9	16	2.862
Feb	3.3	17	2.824
Mar	3.3	18	2.786
Apr	3.1	19	2.748
May	2.9	20	2.71
Jun	2.7	21	2.672
Jul	2.6	22	2.634
Aug	2.7	23	2.596
Sep	2.3	24	2.558
Oct	2.5	25	2.52
Nov	2.6	26	2.482
Dec	2.6	27	2.444
Jan	2.6	28	2.406
Feb	2.3	29	2.368
Mar	2.1	30	2.33
Apr	2.1	31	2.292
May	0.0	32	2.254
Jun	0.0	33	2.216
Jul	0.0	34	2.178
Aug	0.0	35	2.14
Sep	0.0	36	2.102

SUMMARY OUTPUT

Regression Statistics

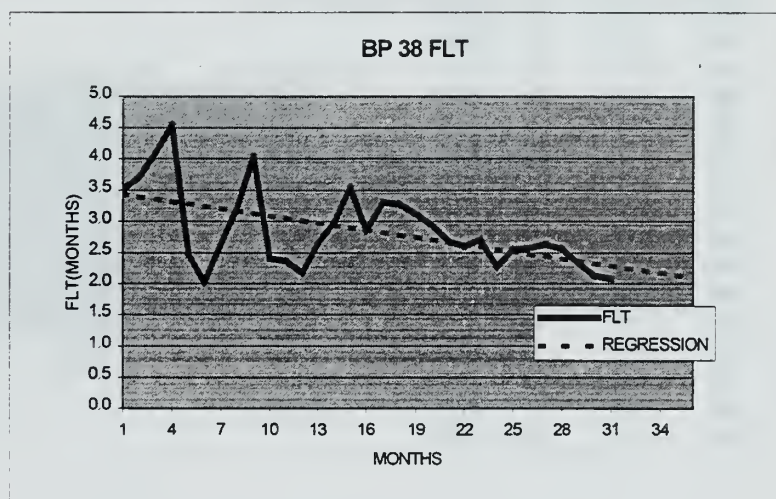
Multiple R	0.54037
R Square	0.292
Adjusted R	0.26759
Standard Error	0.54125
Observations	31

ANOVA

	df	SS	MS	F	Significance F
Regression	1	3.50387	3.50387	11.9606	0.0017
Residual	29	8.49559	0.29295		
Total	30	11.9995			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	3.47338	0.19922	17.4345	6.5E-17	3.06592	3.88083	3.06592	3.88083
X Variable	-0.0376	0.01087	-3.4584	0.0017	-0.0598	-0.0154	-0.0598	-0.0154

THE REGRESSION EQUATION IS $3.47 + (-0.038)x$



BP 34-Z REGRESSION

FLT	X-VALUE	FORECAST FLT
Oct	3.8	1 7.379
Nov	4.8	2 7.758
Dec	5.8	3 8.137
Jan	6.8	4 8.516
Feb	7.8	5 8.895
Mar	15.3	6 9.274
Apr	14.5	7 9.653
May	11.5	8 10.032
Jun	11.5	9 10.411
Jul	10.7	10 10.79
Aug	11.4	11 11.169
Sep	11.1	12 11.548
Oct	10.9	13 11.927
Nov	11.0	14 12.306
Dec	12.0	15 12.685
Jan	13.0	16 13.064
Feb	13.9	17 13.443
Mar	14.5	18 13.822
Apr	15.1	19 14.201
May	15.6	20 14.58
Jun	15.9	21 14.959
Jul	16.6	22 15.338
Aug	17.4	23 15.717
Sep	18.0	24 16.096
Oct	16.5	25 16.475
Nov	14.9	26 16.854
Dec	15.8	27 17.233
Jan	16.6	28 17.612
Feb	17.3	29 17.991
Mar	17.0	30 18.37
Apr	17.8	31 18.749
May	0.0	32 19.128
Jun	0.0	33 19.507
Jul	0.0	34 19.886
Aug	0.0	35 20.265
Sep	0.0	36 20.644

SUMMARY OUTPUT

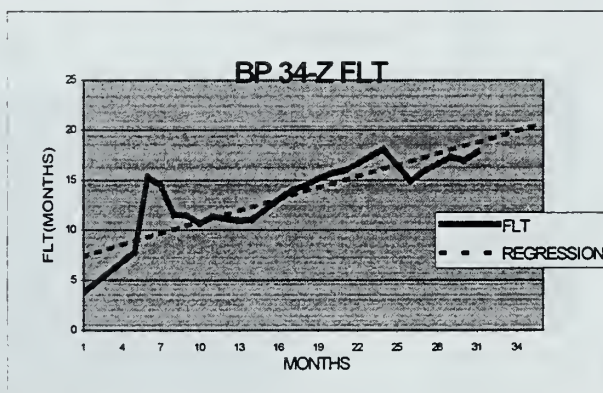
Regression Statistics	
Multiple R	0.8655
R Square	0.749091
Adjusted R	0.740439
Standard E	2.030153
Observatio	31

ANOVA

	df	SS	MS	F	ignificance F
Regression	1	356.8403	356.8403	86.57976	3.3E-10
Residual	29	119.5241	4.121521		
Total	30	476.3644			

	Coefficients	andard Error	t Stat	P-value	ower 95%	pper 95%	ower 95.0%
Intercept	6.998125	0.747261	9.365029	2.86E-10	5.469803	8.526447	5.469803
X Variable	0.379325	0.040766	9.304824	3.3E-10	0.295948	0.462701	0.295948

THE REGRESSION EQUATION IS $7 + .379X$



FLT	X-VALUE	FORECAST FLT
Oct	3.9	1 3.2522
Nov	4.2	2 3.9244
Dec	4.8	3 4.5966
Jan	5.3	4 5.2688
Feb	6.0	5 5.941
Mar	6.3	6 6.6132
Apr	6.7	7 7.2854
May	7.4	8 7.9576
Jun	7.9	9 8.6298
Jul	8.2	10 9.302
Aug	8.7	11 9.9742
Sep	9.6	12 10.6464
Oct	10.5	13 11.3186
Nov	11.5	14 11.9908
Dec	12.5	15 12.663
Jan	13.4	16 13.3352
Feb	14.4	17 14.0074
Mar	15.4	18 14.6796
Apr	16.4	19 15.3518
May	17.4	20 16.024
Jun	18.4	21 16.6962
Jul	19.3	22 17.3684
Aug	20.3	23 18.0406
Sep	20.6	24 18.7128
Oct	20.4	25 19.385
Nov	20.7	26 20.0572
Dec	21.0	27 20.7294
Jan	20.7	28 21.4016
Feb	21.1	29 22.0738
Mar	21.1	30 22.746
Apr	19.4	31 23.4182
May	0.0	32 24.0904
Jun	0.0	33 24.7626
Jul	0.0	34 25.4348
Aug	0.0	35 26.107
Sep	0.0	36 26.7792

BP 34-G REGRESSION

SUMMARY OUTPUT

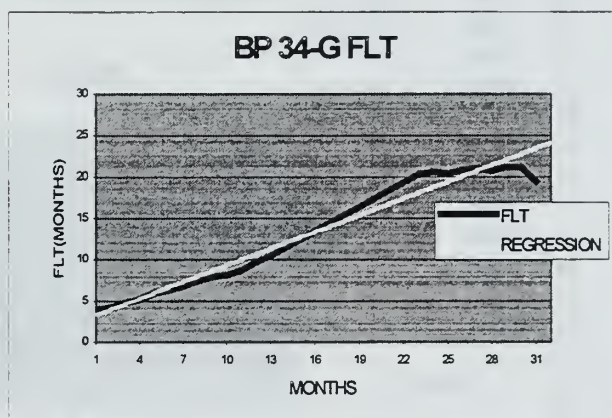
Regression Statistics	
Multiple R	0.979625
R Square	0.959664
Adjusted R	0.958273
Standard E	1.274499
Observatio	31

ANOVA

	df	SS	MS	F	ignificance F
Regression	1	1120.742	1120.742	689.9644	9.08E-22
Residual	29	47.10609	1.624348		
Total	30	1167.848			

	Coefficients	standard Error	t Stat	P-value	ower 95%	pper 95%	ower 95.0%
Intercept	2.581043	0.469119	5.501891	6.29E-06	1.621586	3.540501	1.621586
X Variable	0.672244	0.025593	26.26717	9.08E-22	0.619901	0.724587	0.619901

THE REGRESSION EQUATION IS $2.58 + .6722X$



EP 34-C REGRESSION

FLT	X-value	Forecast FLT
Oct	7.6	1 6.244
Nov	8.1	2 6.833
Dec	8.5	3 7.422
Jan	8.6	4 8.011
Feb	9.0	5 8.600
Mar	9.4	6 9.189
Apr	10.0	7 9.777
May	10.3	8 10.366
Jun	10.4	9 10.955
Jul	10.6	10 11.544
Aug	10.5	11 12.133
Sep	10.9	12 12.722
Oct	11.4	13 13.311
Nov	12.2	14 13.900
Dec	13.2	15 14.489
Jan	14.1	16 15.078
Feb	15.1	17 15.667
Mar	16.1	18 16.256
Apr	17.1	19 16.844
May	18.0	20 17.433
Jun	19.0	21 18.022
Jul	19.8	22 18.611
Aug	20.7	23 19.200
Sep	21.1	24 19.789
Oct	21.2	25 20.378
Nov	21.6	26 20.967
Dec	21.7	27 21.556
Jan	22.4	28 22.145
Feb	22.7	29 22.734
Mar	22.7	30 23.323
Apr	23.1	31 23.911
May	0.0	32
Jun	0.0	33
Jul	0.0	34
Aug	0.0	35
Sep	0.0	36

SUMMARY OUTPUT

Regression Statistics

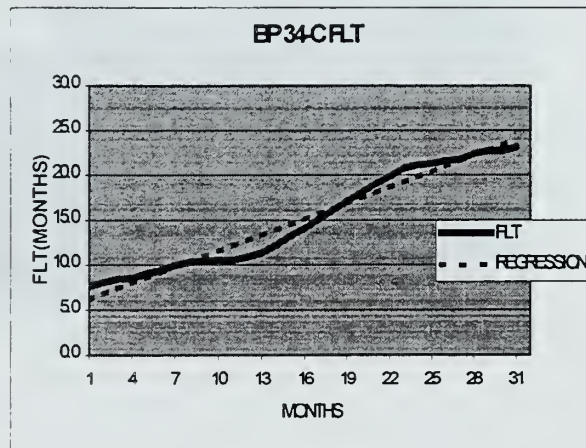
Multiple R	0.982588
R Square	0.965478
Adjusted R	0.964288
Standard E	1.029806
Observation	31

ANOVA

	df	SS	MS	F	Significance F
Regression	1	860.1206	860.1206	811.0511	9.47E-23
Residual	29	30.75453	1.060501		
Total	30	890.8751			

	Coefficients	Standard Error	t Stat	P-value	Lower 95%	Upper 95%	Lower 95.0%	Upper 95.0%
Intercept	5.654529	0.379062	14.91754	3.87E-15	4.879279	6.429779	4.879279	6.429779
X Variable	0.588917	0.020679	28.47896	9.47E-23	0.546623	0.63121	0.546623	0.63121

The regression equation is $5.655 + .588917X$



APPENDIX F

Crystal Ball Report

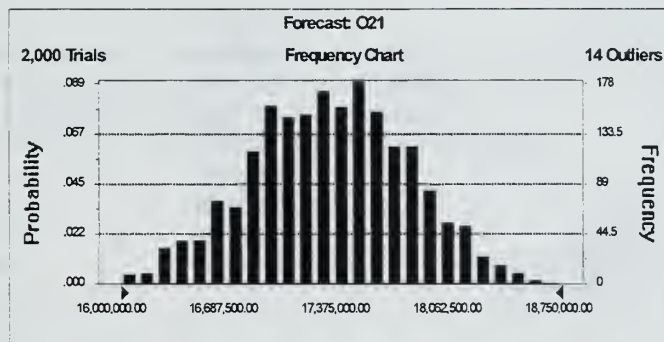
Simulation started on 9/25/98 at 14:47:01
Simulation stopped on 9/25/98 at 14:49:52

Forecast:

Summary:

Display Range is from 16,000,000.00 to 18,750,000.00
Entire Range is from 15,434,635.53 to 18,985,873.28
After 2,000 Trials, the Std. Error of the Mean is 11,146.25

Statistics:	Value
Trials	2000
Mean	17,295,915.04
Median	17,298,327.99
Mode	---
Standard Deviation	498,475.51
Variance	2.48E+11
Skewness	-0.12
Kurtosis	2.94
Coeff. of Variability	0.03
Range Minimum	15,434,635.53
Range Maximum	18,985,873.28
Range Width	3,551,237.75
Mean Std. Error	11,146.25



Forecast: O21 (cont'd)**Cell: O21**

Percentiles:

<u>Percentile</u>	<u>Value</u>
0%	15,434,635.53
10%	16,644,879.20
20%	16,881,701.45
30%	17,031,565.85
40%	17,171,975.80
50%	17,298,327.99
60%	17,437,905.69
70%	17,569,594.01
80%	17,726,374.47
90%	17,911,483.46
100%	18,985,873.28

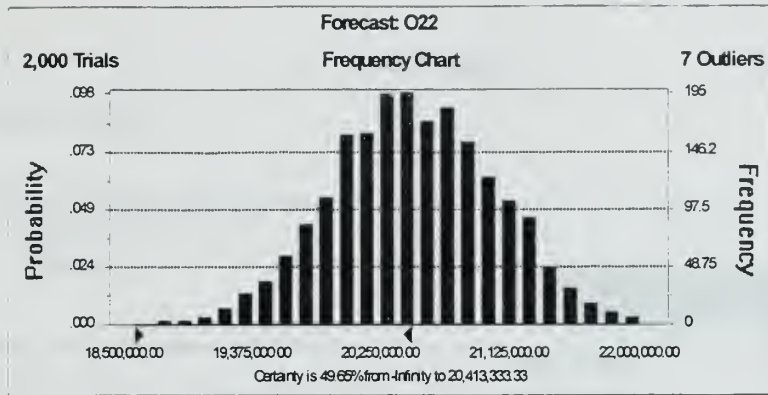
Forecast: O22**Cell: O22**

Summary:

Certainty Level is 49.65%
Certainty Range is from -Infinity to 20,413,333.33
Display Range is from 18,500,000.00 to 22,000,000.00
Entire Range is from 18,495,631.60 to 22,158,505.28
After 2,000 Trials, the Std. Error of the Mean is 12,672.45

Statistics:

	<u>Value</u>
Trials	2000
Mean	20,430,743.47
Median	20,417,913.40
Mode	—
Standard Deviation	566,729.18
Variance	3.21E+11
Skewness	-0.01
Kurtosis	2.89
Coeff. of Variability	0.03
Range Minimum	18,495,631.60
Range Maximum	22,158,505.28
Range Width	3,662,873.68
Mean Std. Error	12,672.45



Forecast: O22 (cont'd)

Cell: O22

Percentiles:

Percentile	Value
0%	18,495,631.60
10%	19,701,205.73
20%	19,955,206.74
30%	20,134,153.69
40%	20,276,897.52
50%	20,417,913.40
60%	20,572,332.06
70%	20,733,508.27
80%	20,914,465.28
90%	21,168,939.54
100%	22,158,505.28

Forecast: outlay

Cell: O23

Summary:

Certainty Level is 49.70%

Certainty Range is from -Infinity to -3,130,000.00

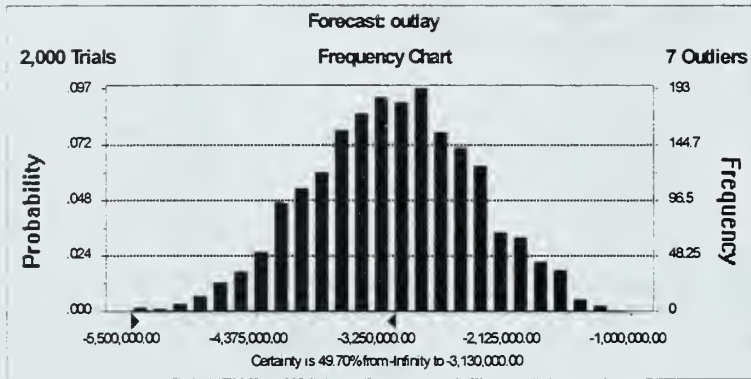
Display Range is from -5,500,000.00 to -1,000,000.00

Entire Range is from -5,502,155.20 to -708,986.51

After 2,000 Trials, the Std. Error of the Mean is 16,728.20

Statistics:

	Value
Trials	2000
Mean	-3,134,828.43
Median	-3,127,605.15
Mode	—
Standard Deviation	748,107.71
Variance	5.60E+11
Skewness	-0.01
Kurtosis	2.86
Coeff. of Variability	-0.24
Range Minimum	-5,502,155.20
Range Maximum	-708,986.51
Range Width	4,793,168.69



Forecast: outlay (cont'd)

Cell: O23

Percentiles:

Percentile	Value
0%	-5,502,155.20
10%	-4,113,829.42
20%	-3,784,191.15
30%	-3,535,356.49
40%	-3,320,186.43
50%	-3,127,605.15
60%	-2,923,116.31
70%	-2,739,887.68
80%	-2,488,803.84
90%	-2,206,088.85
100%	-708,986.51

Assumptions

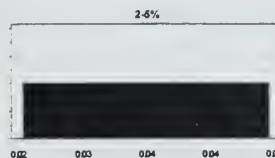
Assumption: 2-5%

Cell: D32

Uniform distribution with parameters:

Minimum	0.02
Maximum	0.05

Mean value in simulation was 0.04



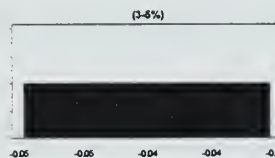
Assumption: (3-5%)

Cell: D31

Uniform distribution with parameters:

Minimum	-0.05
Maximum	-0.03

Mean value in simulation was -0.04



Assumption: Collections

Cell: C11

Triangular distribution with parameters:

Minimum	1,134,129.00
Likeliest	1,537,154.00
Maximum	1,836,081.00

Selected range is from 1,134,129.00 to 1,836,081.00
Mean value in simulation was 1,504,824.21



Mean value in simulation was 1,498,802.71



Assumption: Disbursements

Cell: C12

Triangular distribution with parameters:

Minimum	1,302,482.00
Likeliest	1,595,394.00
Maximum	2,035,727.00

Selected range is from 1,302,482.00 to 2,035,727.00
Mean value in simulation was 1,649,453.58



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